ENGINEERING NEWS

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TABLE OF CONTENTS.

Engineering News of the Week..... 577, 578, 594, 595

Technical and Illustrated Articles:

An Automatic Waste-Gate..... 578
Dams and Reservoir Embankments for Water-Works in the United States and Canada..... 578
Stone Arch at Elyria, O..... 579
Tables for Estimating the Cost of Laying Cast-Iron Water Pipe..... 580
The Proposed Gravity Railroad in Fairmount Park, Philadelphia, Pa..... 582
Experiments on the Efficacy of Filtration Through Sand..... 583
The Highway Bridge of the Future..... 583
Tests of Paving Brick..... 584
Who Should Own the Water Meter?..... 584
A Lubricating Oil Purifier..... 585
Braced Iron Towers..... 593
The View of the Oakland Draw..... 594
Weather Report for May..... 595

Personals, Publications Received, Society Proceedings..... 585, 587

Editorial Notes..... 588

The New York Rapid Transit Commission's Recommendation—The Average Haul Question—Car-Heating—The Sewerage of Paris.

Editorials:

The Mechanical Filtration of Water..... 588
The Laws of Air Resistance..... 589

Notes from Abroad (Editorial Correspondence)..... 590

Correspondence..... 591

The New York Rapid Transit Problem—Grades at Street Intersections—Rail Base Plates—A Question in Town Surveying—A New Use for Ear-Wax.

Railways, Rapid Transit, Highways, Water-Works, Bridges, Tunnels and Canals, Electrical, Sewerage and Municipal, Contracting, Proposals Open, Manufacturing and Technical..... 595, 600

ENGINEERING NEWS.

AQUEDUCT CONTRACTORS O'Brien & Clark have been declared exempt from the time penalty of $1,000 per day for all excess of contract time, and have received their retained percentage of $341,426 on sections 7 and 8. Under this same opinion of the City Counsel and resolution of the Aqueduct Board, Brown, Howard & Co. will receive on Sec. 2 $258,700, Sec. 3, $196,455; Sec. 4, $193,049, and on Sec. 5, $87,572; total, $735,772. The latter firm is also to be paid $124,000, withheld on Oct. 18, 1888, from estimates and for bad work and over-payment. The work in question is now declared complete and is accepted. The attorney for O'Brien & Clark served notice on the Aqueduct Commission last week that they claimed $2,500,000 on sections 7 and 8 over and above the $2,800,000 heretofore paid on these sections, and threaten suit if the claim is not paid within 30 days. Brown, Howard & Co. also claim $3,128,227.16 for "extra work ordered by the engineer in the shape of stone packing and grouting."

THE APPROPRIATION FOR RIVER AND HARBOR IMPROVEMENTS has been increased $3,687,750 by the Senate Committee of Commerce above the amount appropriated in the bill as it passed the House. The more important increases are as follows: Harbor of Refuge at Point Judith, R. I., $100,000; New York harbor, $198,600; Philadelphia, $200,000; Baltimore, $200,000; Charlotte Harbor, Fla., $50,000; purchase of Portage Lake canals, Mich., $350,000; Yaquina Bay, Oregon, $80,000; Potomac River, Washington, $60,000; Great Kanawha River, West Virginia, $140,000; Cape Fear River, North Carolina, below Wilmington, $100,000; St. John's River, Florida, $25,000; Arkansas River, $50,000; Tennessee River, below Chattanooga, $75,000; reservoirs at headwaters of Mississippi, $40,000; Mississippi River, from head of passes to mouth of Ohio, $1,653,000; Missouri River, $350,000.

THE OCEAN CABLE STEAMER *Westmeath*, carrying the Bermuda-Halifax cable, is now surveying the proposed route. It is expected that this survey will be completed about June 25, after which the actual work of laying will commence. The work will be completed about July 1.

"THE CITY OF ROME," after striking on Fastnet Rock, was saved by the prompt closing of a door in the forward bulkhead. Expert examination shows that there is a hole 20 ft. long in the plates on the bow and bad fractures at the meeting of the fore-foot and keel. It will take a considerable time to repair the damage. Modern ship construction again saved the lives of the passengers.

THE FRENCH SUBMARINE BOAT, GOUBET, has recently made some very successful trials at Cherbourg harbor. The boat remained under water two hours, moving from point to point and sinking and coming to the surface apparently without difficulty. The boat is cast in one piece of bronze 18 ft. long and 6 ft. in diameter. Stability is assured by a mass of lead which can be released and attached to the keel. It is propelled by electricity. The crew consists of four men and they are supplied with oxygen which is compressed in tubes containing sufficient for 24 hours.

THE CONTRACT FOR BUILDING THE STEEL PRACTICE CRUISER of 800 tons displacement, bids for which were recently opened, has been awarded to Samuel T. Moore & Co., of Elizabethport, N. J. The vessel is to be a complete man-of-war in miniature, and is intended for use at the Naval Academy in the practical education of the cadets.

THE BROOKLYN SIMPSON DRYDOCK has been officially tested by a board made up of Capt. BEARDSLEE, U. S. N., Civil Engineers ENDICOTT and MCCOLLOM and Naval Constructor HANSCOM. They report it complete in all respects and recommend that it be accepted.

Mr. LEARY'S DRY-DOCK SCHEME, for St. John, N. B., seems to be dead, but the City Council has accepted his wharf building proposition by a close vote. Mr. LEARY proposes to build at Carleton a wharf with warehouses and railway tracks, to dredge to 27 ft. on the outside of wharf and to build another wharf on his own property at Sand Point and a 50,000-bushel grain elevator. In consideration of this work the city is to guarantee him $5,000 per annum for twenty years, and further subsidies of $5,000 per year each from the Dominion and Provincial governments.

THE ELIZABETH, N. J., GRADE CROSSING was the subject of a resolution of the Elizabeth Council on June 10, which passed by a vote of 16 to 6. The resolution aimed at the abolition of the grade crossing in that city by the elevation of the Pennsylvania tracks and the depression of the New Jersey Central's tracks, at an expense to the companies of $1,000,000. The city is to assume the payment of all damages to owners of abutting property, and the work is to be completed by Jan. 1, 1893.

THE 32,500 SHARES OF BALTIMORE & OHIO R. R. STOCK held by the city of Baltimore have been sold to a syndicate of New York capitalists. The same syndicate is now negotiating for the stock held by Johns Hopkins University and the State of Maryland. The object of the purchase is to empower the issuance of $10,000,000 of new stock to be expended in improvements necessary to place the road on an equal footing with its competitors. The sale will also do away with the political element representing the city and State which has been the disturbing factor in the company's management. The syndicate purchasing the stock is composed of New York men, but what interest it represents is not definitely known. It is thought, however, that the Richmond & West Point Terminal Co. is closely identified with the movement if not the actual purchaser.

LATER DETAILS in regard to the new stock issue and reorganization scheme of the B. & O. R. R. Co are to the effect that the company will remain independent. Of the 47,000 shares of stock purchased from the city of Baltimore and Johns Hopkins University, 25,000 shares will go to Philadelphia and New York capitalists, in the interest of the Richmond & West Point Terminal and Philadelphia & Reading companies, and the remainder will go to Pittsburgh & Western stockholders and private individuals. According to press dispatches from Baltimore:

A short line will be built from the Baltimore & Ohio Metropolitan branch across the Potomac River to connect with the Richmond & Danville system. In connection with the Pittsburg & Western, a new short route is to be constructed between Baltimore and Chicago. The route will be over the main line to Cumberland, Md.; thence over the Pittsburg & Connellsville to Pittsburg; thence over the P. & W. to Akron, O. A few miles of road will be built from Akron to Chicago Junction, on the Baltimore & Ohio. At Chicago the Baltimore & Ohio will use extensive terminals owned by the Northern Pacific, with which it will exchange a great deal of freight. The Reading will derive the benefit accruing from the large amount of new business destined for New York that will be thrown upon the Baltimore & Ohio. The Baltimore & Ohio will shortly issue $10,000,000 or $15,000,000 of new stock, which will be taken by the present stockholders. The money will be spent in building elevators at Baltimore and on Staten Island, in new branches and in new stations, new equipment and other improvements.

A LOCOMOTIVE TELEPHONE SIGNAL was recently tested by the Baltimore & Ohio R. R. Co., on about three miles of its track, which were equipped with the apparatus. The apparatus consists of a single iron rod running between the rails, supported on insulators, and an electric gong properly connected with a battery carried on the locomotive. The connection between the gong and the iron rod is made by means of an insulated wire from the gong to a wire brush underneath the locomotive, which touches the rod. Two trains approaching each other on the same track will complete a circuit, and warn each other by ringing the gong. The gongs on the two trial trains commenced ringing when they were about two miles apart; the telephone mouthpiece was then switched to the wire and conversation was carried on between the two engineers. The apparatus is stated to have worked very satisfactorily. The signal is manufactured by the Universal Electric Railway Signal Co., of Richmond, Va.

THE WORST ACCIDENT OF THE WEEK was not a very serious one; a runaway due to wet rails on the Western North Carolina R. R. at Melrose, by which 3 were killed and 5 injured, constituting the entire crew of a coal train, which became uncontrollable soon after leaving the summit, finally jumping the track after attaining a speed of over 60 miles per hour. The whole train then plunged headlong down the mountain side and became a complete wreck. The accident will cost $75,000 or thereabouts, which would equip some 1,700 cars with air brakes.

THE ONLY BRIDGE ACCIDENT reported this week was at Beverley Park, Cleveland, June 15. A rustic bridge 35 ft. long, was broken by the people crowded upon it, and 25 persons injured, 8 seriously.

THE GROSS EARNINGS OF 160 RAILWAYS operating 85,816 miles of road for the month of May, as reported by the *Financial Chronicle*, are $37,683,237, an increase of $4,565,484, or 13.79% over the corresponding month of 1889. The greatest gain shown by any group is that of the Southwestern roads, and the greatest gain shown by a single road is that of the Atchison, Topeka & Santa Fé system, $832,476. The Southern roads also show a large increase notwithstanding the indifferent character of the cotton movement and the effect of the recent floods. The Northwestern roads show moderate increases in all cases, with one or two especially noteworthy increases. The trunk lines show generally favorable results, there being a few roads which show decreased earnings; but, with the exception of the Wabash, which shows a decrease of $85,788, these decreases are all small. The month of May shows the largest per cent. increase in gross earnings of any month of the current year, although closely followed by April with an increase of 13.73%, and January with one of 13.21%.

AUTOMATIC AIR BRAKES AND COUPLERS are to be applied hereafter to all new cars, and all old cars in for general repairs and 34 ft. long or over, on the Boston & Albany and all the Vanderbilt lines by agreement among the presidents of the lines. Thus the good work goes bravely on, and three or four years from now both the brake and the coupler questions will be a thing of the past; as also the steam heating question, as was clearly evident from the map of progress in steam heating which appeared in our issue of June 7.

THE BROOKLYN BRIDGE Board of Experts, as so far appointed, consists of SAMUEL SPENCER, M. Am. Soc. C. E., late Vice-Prest. of B. & O. R. R., and now of Drexel, Morgan & Co., appointed by the Mayor of New York, and C. W. BUCKHOLZ, Engineer of Bridges and Buildings, N. Y., Lake Erie & W. R. R., appointed by the President of the Board of Trustees. Both are unquestionably good appointments. The Mayor of Brooklyn has not yet made a choice. Should he make an equally good appointment, as in all probability he will, the Board will be in all re-

spects a suitable and proper one. Superintendent MARTIN, of the bridge, very properly declined to serve on the Board at the last meeting of the Board of Trustees.

THE NEW ORLEANS BRIDGE was again the subject of lively debate, on June 12, at the U. S. Engineer's office in that city. The meeting was called by order of General CASEY to hear objections to the two proposed bridge plans. As a general result the railway men seem to be strongly opposed to the lower bridge; for the reason the main trunk lines, on both sides of the river, approach very near to a point above the city where a bridge would be feasible; the lower bridge would be below their terminals and only increase risks on their shipments to sea; the upper bridge would be more convenient for the majority of the railways, etc. On the other hand, Mayor SHAKESPEARE favored the lower bridge because the tonnage was greater down river than up, and the up-river tonnage was mainly of barges under tow that would be much obstructed by an upper bridge. The various insurance companies favored the lower bridge, as also did the steamship agents; but the river pilots, steamship captains, Southern Pacific R. R., and the Board of Harbormasters united in objecting to the lower bridge. While the assembly was much divided in their opinions the advocates of the bridge above the city seemed to have a decided majority.

THE CHANNEL TUNNEL BILL having again been thrown out by the House of Lords, despite the sanguine hopes of Sir EDWARD WATKIN, another scheme is attracting some attention. The chief objection to a tunnel—by the English military element—is to the ease of outlet. M. BUNAU VARILLA, a young French engineer, now comes forward with a plan for a shaft at each end of a tunnel line, with the trains let down on enormous "lifts," and the shaft at the sea end of embankments half a mile long. This shaft outlet could be shelled by ships or forts in case of necessity, says the proposer. But the necessary delay in making up trains by this plan seems as unnecessary as the military fear of "invasion" by a regular tunnel seems silly.

ANOTHER TUNNEL UNDER THE ST. CLAIR RIVER is to be built by the Grand Trunk Railway at a cost of between $2,000,000 and $3,000,000. It is to be commenced at once. Of the tunnel now under construction under the same river 600 ft. are completed. As showing the necessity of such tunnels the Grand Trunk Railway reports 101,445 cars crossing the river at Port Huron during the five months ending May 31 last.

THE RECENT DISCOVERY OF OIL along the banks of the Mercer Co., O., reservoir, which is the main feeder of the Miami & Erie canal, has led to the formation of two syndicates whose object it is to lease the entire tract and commence boring for oil underneath the reservoir bed. The oil fields in the vicinity of the reservoir are among the richest in the state, and there is evidence of a large deposit underneath the reservoir.

THE CHESAPEAKE & OHIO CANAL RECEIVER'S REPORT, just issued, concludes that the prospective revenue which can be derived from the canal and its properties does not justify the expenditure of the $263,608, which the engineer's report calls for, in its restoration.

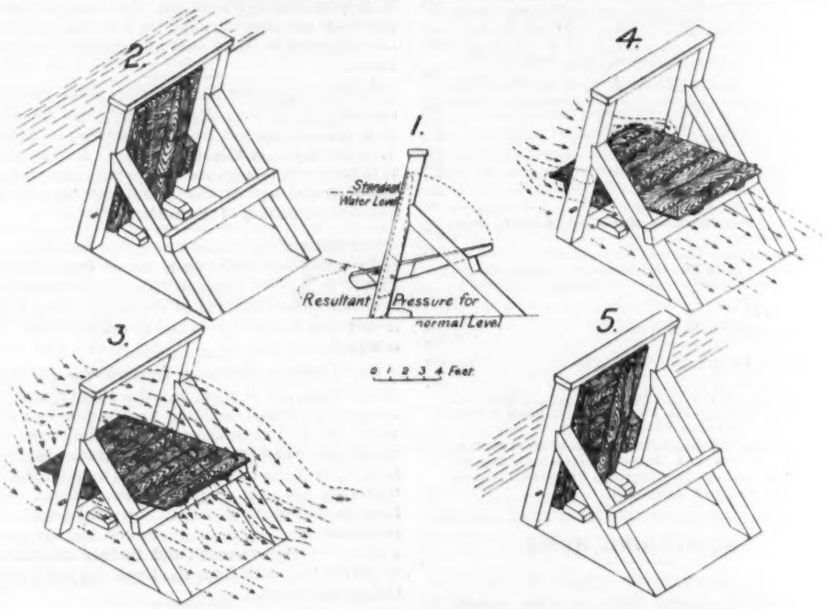
THE BERLIN-STETTIN SHIP CANAL is to be the next great European canal, says Herr SCHECK, a German engineer, who has examined the route. The distance is about 100 miles, over sandy plains and marshes, and the estimated cost is $40,000,000.

ALL WORK ON THE CAPE COD CANAL was abandoned on June 9. It is thought a change of management is about to take place, and that work may be soon renewed.

ELECTRIC LIGHT ON THE SUEZ CANAL.—In his last report to the Foreign Office the British Consul at Port Said gives the following interesting figures with regard to the application of the electric light to vessels navigating the Suez Canal at night: In 1887 395 steamers used the light; in 1888 the number rose to 1,611, while in 1889 a total of 2,445 vessels navigated the canal with its aid. The average time of transit has been reduced to 22½ hours. The shortest time taken by a steamer in passing through the canal in 1889 with the aid of light was 14¾ hours.

An Automatic Waste-Gate.

The automatic waste-gate here illustrated was designed by the well-known irrigation engineer, Mr. A. D. FOOTE, C. E., and by Mr. C. H. TOMPKINS, Jr., his assistant. The action of the gate is clearly indicated in the several figures shown. When the water rises above the normal water level, indicated by the "standard" line on Fig. 1, the gate is overbalanced and automatically opened, as shown in Fig. 3. As the water falls, the pressure on the lower part (see Fig. 4) of the balanced gate closes it again and holds it in this position until the normal level is again reached. This gate was designed in March, 1888, and, we believe, has been very successfully tested.



Automatic Waste-Gate; Designed by A. D. Foote and C. H. Tompkins, Jr.

Dams and Reservoir Embankments for Water-Works in the United States and Canada.

WITH INSET.

The plans, sections and elevations of dams and reservoir embankments which make up our inset this week are selected from the illustrations in the forthcoming *Manual of American Water-Works*. None of them have appeared in this journal before and none, to our knowledge, in any other journal.

We give below brief descriptions of each of the dams and embankments, which will supplement the data on the inset. More detailed descriptions of some of these will be given in the 1889-90 *Manual*, together with many illustrations not herewith presented, and more or less full descriptions of all the other water-works dams in the United States and Canada.

Portland, Me.—Dam at Lake Sebago: This dam is of masonry in cement, with a 126-ft. rollway. There is a spillway at the end of the rollway, consisting of five culverts, each 4 ft. wide by 6 ft. high, all controlled by gates. The dam was built in 1878 by the Presumscot Water Co. to raise the level of the lake. It leaks but little. It was designed by JNO. E. WARREN, and constructed under the direction of CHAS. R. GOODELL, both of Cumberland Mills.

Munjoy Hill Reservoir Embankment: This distributing reservoir has a capacity of 20,000,000 galls., and an area of four acres. Engineer, J. HERBERT SHEDD. Contractor, JAS. J. NEWMAN. Both of Providence, R. I. Cost, $125,000.

The Engineer, Mr. SHEDD, informs us that the section fails to show the curved junction of the toe of the inner slope with the bottom of the reservoir; also that the paving extends to the top of the inner slope, and that the water in the reservoir is 42 ft. deep.

Windsor, Vt.—Dudley Brook Dam and Gate-House: This dam is of clay and gravel, puddled, and has no heart-wall. It is 170 ft. long, 31 ft. high, 4 ft. thick at the top and 97 ft. at the base. Both slopes are 1½ to 1, and the inner is paved with 14 in. of stone. The center of the dam, lengthwise, is founded on rock, while a part of the embankment is on clay. Near the middle of the site a trench 4 ft. wide and 2 ft. deep was dug and filled with clay. The spillway is of masonry and is in the dam; it is 36 ft. wide and 6 ft deep, free. A 10-in. supply and an 8-in. waste pipe extend through the dam from the stone masonry gate-house shown in the section. The dam does not leak. It forms a reservoir with a capacity of 4,000,000 galls. and an area of ¾ acres. It was built in 1888, after plans by the Engineer of the Water-works, GEO. E. LELAND, and under the direction of JNO. T. LANGFORD, Boston. The labor was done by the village without contractors.

Brockton, Mass.—Salisbury Brook Dam: This dam is of clayey gravel, with an extreme length of 1,524 ft. Its greatest height above the natural surface is 23.2 ft., and top width is 16 ft. The inner slope is 2 to 1, the outer 1¾ to 1. The inner slope is paved for ⅔ of the distance down from the top with 18-in. cobbles, and the remaining distance is covered with small stone to a depth of about 2 ft. The up-stream side of the dam was puddled in 18-in. layers; the down-stream side was puddled about a third of the way up, then built in 3-ft. layers. The heart-wall is of rubble concrete, rammed, and is stepped from a width of 3 ft. just above its foundation, which is considerably wider, to 1½ ft. at the top. It is strengthened by slightly projecting pilasters, about 8 in. wide, some 5 ft. apart. The earth beneath the dam was removed to solid gravel bottom, excepting for distance of about 150 ft. along the length of the dam at the center. Here clean sand was found, and a row of 4-in. spruce sheet-piling was driven beneath the center of the heart-wall to a depth of from 3 to 16 ft.

The spillway is of masonry, at the extreme end of the dam; it is 24 ft. wide, with the top of its sill 1 ft. below normal high-water, and with a flushboard 1 ft. high; it has a rubble concrete foundation, and slopes about 4 to 1. A 30-in. discharge-pipe, laid in solid concrete, extends through the dam, and connects with the 24-in. supply main; it is provided with a 30-in. waste gate. Alongside this pipe is a 12-in. waste pipe, connecting directly with the reservoir. Both pipes draw water from the bottom of the pond. The normal depth of water in the gate house is 14 ft The dam shows no sign of leakage. It forms an impounding reservoir with a capacity of about 330,000,000 galls. and an area of about 90 acres. Built in 1880-1. Engineer, PHINEAS BALL, Worcester, with E. L. BROWN, Brockton, as Assistant. Contractors, J. W. BROWN & Co., Providence, R. I. Cost, about $50,000.

Cambridge, Mass.—Stony Brook Dam; Section and Plan: Selected gravel, puddled and rolled, was used for the embankment. The dam is 706 ft. long and 25 ft. high, with a wing embankment about 200 ft. long. The heart-wall is of grouted masonry, 8 ft. wide at the bottom and 3 at top. A discharge-culvert, 5¾ by 13 ft., leads from the gate-house to the foot of the outer slope. The dam leaks a little at one end, through the original bank. It forms an impounding reservoir, with a capacity of 350,000,000 galls. and an area of about 72 acres. It was built in '85-87. Designing Engineer, WM. S. BARBOUR. Constructing Engineer, N. HENRY CRAFTS, Boston. Contractors, H. H. PIKE & SON, Cambridgeport. Cost, $259,000.

New Bedford, Mass.—Dam on Acushnet River: Of earth, 650 ft. long. The upper half of the dam is of fine gravel, coarse sand and loamy sand, selected from banks near by and carted on in 6-in. layers. The heart-wall is of the same material, puddled. There is a spillway and overfall, 50 ft. wide, located 75 ft. from the east end of the dam. The spillway begins 150 ft. above the dam, and is carried 750 ft. below it, the last 500 ft. being through a

swamp to the river. It is entirely free. The spillway is paved with 1 ft. rubble granite, and the overfall with dressed granite. The paving rests on 1 ft. or more of concrete. The foundation was originally of timber and plank, but this was swept away by the freshet of Feb. 14-16, 1886.

There is a gate-house at the west end of the dam, of dressed masonry in hydraulic cement, on a timber and plank foundation. A discharge pipe extends from the gate-house through the dam and connects with the brick supply-conduit. The water in the reservoir can be drawn down from 9 to 10 ft.

The dam was built for storage in 1866, with WM. J. MCALPINE as designing, GEO. A. BRIGGS as constructing engineer, and GEO. W. LOBDELL as contractor. Original cost, $18,846; cost of repairs and improvements, $45,557; total cost, $64,403. It has a capacity of 400,000,000 galls., and a normal water surface of 300 acres.

In 1867, soon after the reservoir was filled, leaks began to appear, and in February, 1868, the gate-house and 100 ft. of the bank were swept away. Mr. MCALPINE attributed the failure to the saturation of fine sand beneath the gate-house and culvert, which caused this material to act as quicksand. In rebuilding the damaged part this sand was confined by two rows of sheet-piling, 15 ft. apart.

West Haven, Conn.—Cove River Dam; Elevation and Section: This is a rubble masonry dam, on rock, with a heart-wall 4 ft. thick for about 17 ft., then 2 ft. thick There is a 12-in. discharge and a 12-in. waste-pipe. The dam does not leak. It forms an impounding reservoir with an area of about 5 acres. It was built in 1884, with D. GOFFE PHIPPS as engineer, and the Connecticut Patent Water Pipe Co., all of New Haven, as contractors. Cost, $3,700.

Waterville, N. Y.—Dam for distributing reservoir: This dam is 240 ft. long, 17 ft. high and 400 ft. down the stream from another dam forming a storage reservoir. It has a spillway 25 ft. wide. It forms a reservoir with a capacity of 1,500,000 galls., which is divided into two parts by a gravel bank serving as a filter. Built in 1888. Engineer, WM. B. RIDER, South Norwalk, Conn. Contractor, G. W. WHITE, Pulaski.

Bound Brook, N. J.—Dams on Middle Brook Plans, Elevations and Sections: These form storage and distributing reservoirs, with a combined capacity of 10,700,000 galls. They were built in 1888, with ISAAC CASSIN, Philadelphia, designing engineer, SYLVANUS AYRES, Jr., Bound Brook constructing engineer, and WRIGHT & HUGHES, Newton, Conn., contractors. Cost, $8,500.

Newark, N. J.—Receiving Reservoir: This reservoir is 297 x 404 ft., with 20 ft. of water, and a capacity of 14,000,000 galls. The inner slopes are 1½ to 1, with a 12-in. pavin cement.

Low Service Distributing: This reservoir is on the site of an old quarry, and has several feet of stone chips in its bottom. It gave way several times, and finally the loose material at the foot of the inner slopes was removed to solid rock, and the trench filled with puddled clay. The reservoir has a capacity of 21,000,000 galls., and is 454 ft. in diameter, with 20 ft. of water. It was built in '71-3.

High Service Reservoir: Capacity, 9,000,000 galls.; 254 x 302 ft., with 20 ft. of water.

All of these reservoirs are of earth, evidently well paved, with a part of their banks of puddle, as shown by the cuts.

Pierre, S. Dak.—Covered reservoir: Excavated in hard loam to a depth of 27¼ ft. at the sides and 31½ ft. at the centre. The bottom is lined with 18 ins. of concrete. The reservoir has a capacity of 1,000,000 galls., and the flow is controlled by an automatic valve.

St. Louis, Mo.—Compton Hill Storage Reservoir Embankment: The construction is fully shown by the cut. The reservoir has a capacity of 60,000,000 galls., and a depth of about 20 ft.

Montreal, P. Q.—McTavish Street Reservoir Embankment: Excavated in rock, with embankment on one side, as shown by the cut. There are two 24-in. discharge pipes. Built in 1856 for low-service, with a capacity of 15,000,000 imp. galls.; enlarged in '62-78 to a capacity of 35,000,000 imp., or 43,000,000 U. S. galls. Engineers, THOS. C. KEEFER, Ottawa, Ont., and LOUIS LESAGE, Montreal.

Quebec, P. Q.—Dam on St. Charles River, at Lorette: This dam is of masonry, 200 ft. long, with overfall throughout its length. There are an 18 and a 30-in. discharge-pipe, each with a slope of 0.66 in 100; also a culvert 5 ft. in diameter. The dam has not leaked, except through the joints of the upper layer of cut stone. This leakage has been caused by the disintegration of the cement joints, resulting from the action of frost and water. The dam forms a reservoir with a capacity of 100,000,000 galls., and an area of 34 acres. It was built in 1851-3, with GEO. R. BALDWIN as Engineer, and JOSEPH ARCHER, Quebec, as contractor. Cost, $33,000.

London, Ont.—Reservoir Embankment: This embankment is built across one side of a natural depression. It forms a reservoir 200 ft. sq., with a capacity of 7,000,000 galls. It was built in 1878. Designing engineers, ROBINSON & TRACY. Constructing engineer, THOS. H. TRACY, London. Cost, $28,000.

For the convenience of those interested we append a list of the illustrations of water-works dams and reservoirs which have appeared in previous numbers of this Journal, giving the volume and page. Those starred will be included in whole or in part in the 1889-90 *Manual*, in addition to those shown on the accompanying inset.

* Bangor, Me.: Section of timber dam at Treats Falls; vol. IV., p. 60.

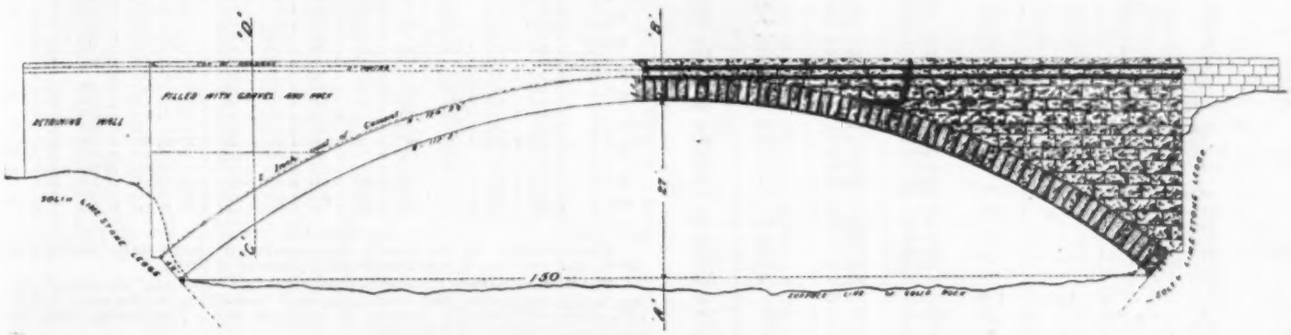
Boston, Mass.: Earth dams connected with the Mystic Supply; vol. V., p. 100. Also plan and cross-section of the Fisher Hill reservoir; vols. XIV., p. 223, XIX., pp. 226-7.

* Quincy, Mass.: Longitudinal and cross-sections of earth dam on Town Brook; vol. XXI., p. 565.

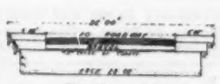
Wellesley, Mass.: Plan, cross-section, section of gate-house and details of Maugus Hill reservoir; vol. XIV., p. 231.

* Pawtucket, R. I.: Longitudinal and cross-section of earth dam forming Diamond Hill Reservoir; vol. XXI., p. 493.

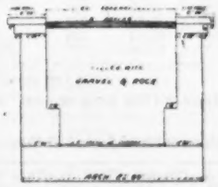
*Bridgeport, Conn.: Cross-section of masonry dam on



Stone Highway Arch at Elyria, Ohio. E. C. KINNEY, *Engineer.*



Section AB.



Section CD.

Mill river, with plan and section of gate-chamber; vol. XVII., pp. 230, 231.

New York, N. Y.: Plan showing Croton dam and gate-house connected with same; also progress view of construction of the gate-house; vol. XX., pp. 200-1. Also plan of Sodom dam with cross-sections of both the masonry dam and of the earth embankments, views of cable plant for the construction of the dam, and details of the whole; vol. XX., pp. 421-23. Also Quaker Bridge dam, various illustrations, vol. XI., pp. 171, 174, 189; vol. XV., pp. 130, 131; vol. XIX., pp. 20, 21, 81, 82, 83, 163; vol. XX., pp. 345, 348, 349, 389, 390, 391. Also dam for reservoir M., on Titicus river, inset showing elevations, sections and details in our issue of March 22, 1890.

New Brunswick, N. J.: Cross-section (sketch) of dam on Lawrence brook, illustrating the failure of the dam Feb. 25, 1888; vol. XIX., p. 166. Also plan, elevation and cross-section of a proposed new masonry dam, with diagram showing estimated strains; vol. XIX., pp. 490-1, 511.

Athens, Ga.: Plan, sections and details of dam and reservoir; vol. XIX., p. 355.

Knoxville, Tenn.: Plan of reservoir, showing breaks in bottom; vol. X., p. 340.

*Nashville, Tenn.: Plan of reservoir built in 1889, with cross-sections of masonry, main and division walls, and section showing method of excavating and filling; vol. XIX., p. 484.

Covington, Ky.: Insets showing plan, sections and details of new reservoir were given in numbers for May 16 and 17, 1890.

*Hudson, Wis.: Plan and sections of underground reservoir; vol. XXIII., p. 249.

Kansas City, Mo.: Section of upper and lower reservoir embankments, view of Quindaro settling basins, and diagrams showing method of cleaning; vol. XVIII., pp. 346, 347, 401.

Little Rock, Ark.: Section of dividing wall between upper and lower basins of settling reservoir, showing cause of failure; vol. XVIII., pp. 352, 405.

San Francisco, Cal.: Views showing construction of San Mateo (Spring Valley) dam; vol. XXXI., pp. 182-4.

* Bear Valley Dam (near Redlands, Cal.): Section and elevation; vol. XIX., p. 270. Also plan and sections and details of the new Bear Valley dam; vol. XXII., pp. 484-5.

* Sweetwater Dam (near National City, Cal.): Views; vol. XIX., p. 271. Also elevation, sections and details; vol. XX., p. 324.

Reference may also be made to the Great Masonry Dams of the World, plans of which appeared in vol. XIX., p. 17, and elevations of which were given on an inset in the same number, Jan. 7, 1888.

Stone Arch at Elyria, Ohio.

We are indebted to Mr. E. C. KINNEY for the accompanying scale drawings of the fine stone arch at Elyria, Ohio, of which we gave a view and description in our issue of May 31, with an important correction as to depth of keystone and radius of arch on June 7. The accompanying drawing shows both correctly, and also various other dimensions, but we have made one change in the drawing as sent us, viz., to add the bracket or bay over the haunches of the arch, which was not in the original design, but was added subsequently by another hand, as the following letter shows:

ELYRIA, O., June 5, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of May 31 I notice in your descriptive article on the arch in this city some mistakes which I will correct and trust it will make the bridge appear still more remarkable.

The span is 150 ft. with a rise of 24 ft., instead of 27 ft., as given. The stone was quarried in Elyria, not Amherst. I also think there should be some credit given to the builder of this arch.

Mr. E. C. KINNEY prepared the original plans, which were afterward modified and the projections in the walks added by myself. The construction was laid out and carried to completion by Mr. JOHN WELLER, without the assistance of the engineer, he having gone to fill the position which he now holds with the Union Pacific Ry.

The bridge has a more graceful appearance than it would have had had it been constructed according to the plans adopted by the County Commissioners, and while it is not my intention to detract any credit from Mr. KINNEY, I feel that justice demands that the man whose brainwork and knowledge of building carried this fine arch to successful completion should enjoy a slight mention in connection therewith. GEO. L. WELLER.

If the rise of the arch was reduced from 27 ft. to 24 ft., as stated above, it would increase the radius to 129.2 ft., and the proper depth of key by Trautwine's rule would be 3.77 ft., or almost precisely the same as the actual key, which is 3 ft 9 ins. (the figures being somewhat indistinct in the engraving) We agree that the addition of the bays or projections was a decided improvement, but even without them the arch would be a beautiful and creditable structure.

TABLES FOR ESTIMATING THE COST OF LAYING CAST-IRON WATER PIPE.

BY EDMUND B. WESTON, M. AM. SOC. C. E., ENGINEER OF THE WATER DEPARTMENT, PROVIDENCE, R. I.

TABLE NO. 1.

WEIGHT OF WATER PIPES, OF THE "PROVIDENCE PATTERN."
Length, 12 ft. over all.

Nominal diameter in ins.	Class.	Thickness of shell in ins.	Length that pipe will lay.	Depth of bell in ins.	Weight in pounds. per running ft. as laid.	Weight in pounds. per running ft. of shell.	Standard weight in lbs.	Greatest proposed head in ft.
4	*a*	13-32	11.83	2.00	19.61	18.11	232	60
	A	7-16	"	"	20.88	19.37	247	100
	b	7-16	"	"	20.88	19.37	247	140
	B	15-32	"	"	22.06	20.61	261	180
	C	15-32	"	"	22.06	20.61	261	220
	D	15-32	"	"	22.06	20 61	261	260
6	*a*	7-16	11.83	2.00	30.25	28.25	358	60
	A	15-32	"	"	32.11	30.12	380	100
	b	1/2	"	"	33.98	31.99	402	140
	B	1/2	"	"	33.98	31.99	402	180
	C	17-32	"	"	35.75	33.81	423	220
	D	17-32	"	"	35.75	33.81	423	260
8	*a*	15-32	11.82	2.15	42.64	39.93	504	60
	A	1/2	"	"	45.09	42.43	533	100
	b	17-32	"	"	47.63	44.92	563	140
	B	9-16	"	"	49.92	47.39	590	180
	C	19-32	"	"	52.53	49.84	621	220
	D	19-32	"	"	52.53	49.84	621	260
10	*a*	1/2	11.81	2.27	56.13	52.58	663	60
	A	17-32	"	"	59.27	55.70	700	100
	b	9-16	"	"	62.31	58.80	736	140
	B	19-32	"	"	65.37	61.89	772	180
	C	5/8	"	"	68.50	64.95	809	220
	D	21 32	"	"	71.54	68.00	845	160
12	*a*	17-32	11.80	2.40	71.19	66.81	840	60
	A	9-16	"	"	75.00	70.57	885	100
	b	5/8	"	"	82 37	78.02	972	140
	B	21-32	"	"	85.10	81.72	1,016	180
	C	11-16	"	"	89.75	85.40	1,059	220
	D	23-32	"	"	93.47	89.06	1,103	260
16	*a*	19-32	11.78	2.70	105.31	98.77	1.240	60
	A	21-32	"	"	115.28	108.76	1,358	100
	b	11-16	"	"	120.34	113.73	1,417	140
	B	3/4	"	"	130.14	123.61	1,533	180
	C	13-16	"	"	139.96	133 41	1.648	220
	D	27-32	"	"	144.88	138.28	1,706	260
20	*a*	21-32	11.75	2.95	145.14	135.80	1,706	60
	A	23-32	"	"	157.62	148.29	1,852	100
	b	25-32	"	"	169.98	160.70	1,998	140
	B	27-32	"	"	182.38	173.05	2,143	180
	C	29-32	"	"	194.99	185.30	2,292	220
	D	31-32	"	"	207.24	197-49	2,436	260
24	*a*	23-32	11.73	3.20	190.83	177.91	2,239	60
	A	13.16	"	"	213.30	200.36	2,502	100
	b	7/8	"	"	228.16	215.24	2,677	140
	B	15-16	"	"	242.97	230.03	2,850	180
	C	1 1-32	"	"	266.00	252.09	3,121	220
	D	1 3-32	"	"	280.66	266.70	3,293	260
30	*a*	13-16	11.70	3.60	269.66	250.33	3,155	60
	A	29-32	"	"	297.78	278.38	3,484	100
	b	1	"	"	325.56	306.25	3,809	140
	B	1 1-16	"	"	344.10	324.74	4,026	180
	C	1 3-16	"	"	382.56	361.48	4,476	220
	D	1 9-32	"	"	409.91	388.83	4,796	260
36	*a*	7/8	11.67	4.00	351.41	323.93	4,101	60
	A	1	"	"	396.49	368.88	4,627	100
	b	1 1/8	"	"	441.13	413.72	5,148	140
	B	1 1/4	"	"	485.60	458.15	5,667	180
	C	1 11-32	"	"	522.07	491.27	6,091	220
	D	1 15-32	"	"	566.04	535.17	6,604	260
48	*a*	1 5-32	11.54	5.50	632.06	569.93	7,295	60
	A	1 5-16	"	"	707.09	644.91	8.161	100
	b	1 13-32	"	"	781.60	719.42	9,021	140
	B	1 1/2	"	"	855.68	793.49	9,876	180
	C	1 25-32	"	"	939.20	867.60	10,840	220
	D	1 15-16	"	"	1,012.33	940.10	11,684	260

TABLE No. 2.

ESTIMATED AVERAGE COST PER LINEAL FOOT OF LAYING CLASSES A AND B, OF CAST-IRON WATER PIPE OF THE "PROVIDENCE PATTERN," AND EXCAVATING AND BACK-FILLING FOR THE SAME, IN MEDIUM DIGGING, WHEN THE MARKET VALUE OF THE PIPE, IS AT DIFFERENT RATES PER TON. GATES AND "SPECIALS" ARE INCLUDED, BUT NOT HYDRANTS.

Cost per Ton, and Class.		Diameter of Pipe in Inches. 4	6	8	10	12	16	20	24	30	36	48	Cost per Ton, and Class.
$25	A.	0.426	0.610	0.789	1.008	1.245	1.899	2.604	3.502	4.949	6.360	11.007	A.
	B.	0.410	0.635	0.848	1.079	1.377	2.076	2.902	3.855	5.500	7.396	12.735	B. $25
26	A.	0.437	0.627	0.812	1.038	1.283	1.957	2.684	3.608	5.096	6.547	11.341	A.
	B.	0.422	0.653	0.873	1.112	1.420	2.142	2.993	3.975	5.670	7.625	13.138	B. 26
27	A.	0.448	0.644	0.835	1.068	1.320	2.015	2.763	3.714	5.243	6.734	11.675	A.
	B.	0.463	0.671	0.898	1.145	1.463	2.207	3.085	4.095	5.839	7.854	13.541	B. 27
28	A.	0.459	0.661	0.858	1.098	1.358	2.074	2.843	3.819	5.391	6.921	12.009	A.
	B.	0.475	0.689	0.923	1.178	1.506	2.272	3.176	4.215	6.009	8.082	13.944	B. 28
29	A.	0.470	0.678	0.880	1.128	1.396	2.132	2.923	3.925	5.538	7.109	12.343	A.
	B.	0.486	0.707	0.948	1.211	1.550	2.338	3.268	4.334	6.178	8.311	14.347	B. 29
30	A.	0.481	0.695	0.903	1.158	1.434	2.190	3.002	4.030	5.686	7.296	12.677	A.
	B.	0.498	0.725	0.973	1.244	1.593	2.403	3.359	4.454	6.348	8.540	14.750	B. 30
31	A.	0.492	0.712	0.926	1.188	1.472	2.248	3.082	4.136	5.833	7.483	13.011	A.
	B.	0.510	0.743	0.998	1.276	1.636	2.468	3.451	4.574	6.517	8.768	15.154	B. 31
32	A.	0.503	0.729	0.948	1.218	1.510	2.307	3.162	4 241	5.980	7.671	13.345	A.
	B.	0.521	0.761	1.023	1.309	1.679	2.534	3.542	4.693	6.686	8.997	15.557	B. 32
33	A.	0.514	0.746	0.971	1.248	1.548	2.365	3 241	4.347	6.128	7.858	13.679	A.
	B.	0.533	0.779	1.048	1.342	1.722	2.599	3.634	4.813	6.856	9.226	15.960	B. 33
34	A.	0.525	0.762	0.994	1.278	1.586	2.423	3.321	4.453	6.275	8.045	14.013	A.
	B.	0.544	0.797	1.073	1.375	1.766	2.664	3 726	4.933	7.025	9.454	16.363	B. 34
35	A.	0.536	0.779	1.017	1.308	1.624	2.481	3.400	4.558	6 423	8 232	14.347	A.
	B.	0.556	0 815	1.098	1.408	1.809	2.730	3.817	5.052	7.185	9.683	16 766	B. 35
36	A.	0.547	0.796	1.039	1.338	1.662	2.540	3.480	4.664	6.570	8.420	14.681	A.
	B.	0.568	0.833	1.124	1.440	1.852	2.795	3.909	5.172	7.364	9.912	17.169	B. 36
37	A.	0.558	0.813	1.062	1.368	1.699	2.598	3.560	4.769	6 717	8.607	15 015	A.
	B.	0.579	0.851	1.149	1.473	1.895	2.860	4.000	5.292	7.534	10.141	17.572	B. 37
38	A.	0.570	0.830	1.085	1.398	1.737	2.656	3.639	4.875	6.865	8.794	15.349	A.
	B.	0.591	0.869	1.174	1.506	1.938	2.926	4.092	5.412	7.703	10.369	17.975	B. 38*
39	A.	0.581	0.847	1 108	1.427	1.775	2 714	3.719	4.981	7.012	8.981	15.683	A.
	B.	0.602	0.887	1.199	1.539	1.981	2.991	4.183	5.531	7.873	10.598	18.379	B. 39
40	A.	0.592	0.864	1.130	1.457	1.813	2.773	3.798	5.086	7.160	9.169	16.017	A.
	B.	0.614	0.905	1.224	1.572	2.025	3.056	4.275	5.651	8.042	10.827	18.782	B. 40
41	A.	0.603	0.881	1.153	1.487	1.851	2.831	3.878	5.192	7.307	9.356	16.351	A.
	B.	0.626	0.923	1.249	1.605	2.068	3.122	4.368	5.771	8.211	11.055	19.185	B. 41
42	A.	0.614	0 898	1.176	1.517	1.889	2.889	3.958	5.297	7.454	9.543	16 685	A.
	B.	0.637	0.941	1.274	1.637	2.111	3.187	4.458	5.890	8.381	11.284	19 588	B. 42
43	A.	0.625	0.915	1.198	1.547	1.927	2.947	4.037	5.403	7.602	9.731	17 019	A.
	B.	0.649	0 959	1.299	1.670	2.154	3.252	4.549	6.010	8.550	11 513	19.991	B. 43
44	A.	0.636	0.932	1.221	1.577	1.965	3.006	4.117	5.508	7.749	9.918	17.353	A.
	B.	0.660	0.977	1.324	1.703	2.197	3.318	4.641	6.130	8.720	11.741	20.394	B. 44
45	A.	0.647	0.949	1.244	1.607	2.003	3.064	4.197	5.614	7.896	10.105	17.687	A.
	B.	0.672	0.995	1.349	1.736	2.241	3.383	4.732	6 249	8 889	11 970	20 797	B. 45
46	A.	0.658	0.966	1.267	1.637	2.040	3 122	4.276	5 720	8 044	10 292	18 021	A.
	B.	0.684	1.013	1.374	1.769	2.284	3.448	4.824	6 369	9.059	12 190	21 200	B. 46
47	A.	0.669	0.983	1.289	1.667	2.078	3 180	4.356	5 825	8 191	10 480	18 355	A.
	B.	0.695	1.031	1.399	1.802	2.327	3.514	4.915	6 489	9.228	12 428	21 604	B. 47
48	A.	0.680	1.000	1.312	1.697	2.116	3.239	4 435	5 931	8 339	10 667	18 640	A.
	B.	0.707	1 049	1.424	1.834	2.370	3 579	5 007	6 609	9.398	12 656	22 007	B. 48
49	A.	0.691	1.017	1.335	1.727	2.154	3 297	4.515	6 036	8 486	10 854	19 024	A.
	B.	0 718	1 067	1.449	1.867	2.413	3.644	5 098	6 728	9 567	12 885	22 410	B. 49
50	A.	0 702	1.034	1.358	1.757	2.192	3.355	4 595	6 142	8 633	11.041	19 358	A.
	B.	0.730	1.085	1.475	1.900	2 456	3 710	5 190	6 848	9 737	13.114	22.813	B. 50

The thickness of the Class A pipe was based upon a static pressure of 100 ft., and the Class B pipe upon a static pressure of 180 ft.

The figures include the cost of pipe, gates and "specials," the cost of carting, laying and setting, and excavating and back-filling for the same, and all other expenses generally incurred in ordinary water pipe laying, with the exception of the cost of hydrants.

The cost of "specials" was based upon $0.025 per pound, with pipe at $30 per ton, the cost of **air-cocks** (used only with pipes having a diameter larger than 20 in.), at $10 each, and the cost of the **gates** the same as given in Table No. 3.

Ordinary labor was considered at $1.50 per day.

Depth of Pipe.—The depth of the axis of the pipe below the surface of the ground has been considered in all cases as 4.67 ft.

TABLE NO. 3.

FOR ESTIMATING THE COST IN DETAIL OF LAYING CAST-IRON WATER PIPE OF THE "PROVIDENCE PATTERN," AND EXCAVATING AND BACK-FILLING FOR THE SAME.

Diameter of pipe in inches.	Cost per lineal foot of laying pipe, etc. Excavation.	Labor. $	Lead.* $	Total. $	Cost of pipe per lineal foot at $1.00 per ton. Class a. h = 60.	Class A. h = 100.	Class b. h = 140.	Class B. h = 180.	Class C. h = 220.	Class D. h = 260.	Per cent. of the cost of pipe to be added for specials.†	Cost of gates and boxes. (including carting). Gates. $	Boxes. @ $0.03.	Total. $	Lead per joint (calculated). Width in inches.	Weight in pounds.	Diameter of pipe in inches.
4	Easy	.0976	.0224	0.120	.0088	.0093	.0093	.0098	.0098	.0098	5.12	13.00	5.75	18.75	1⅛	3.31	4
	Medium	.1276		0.150													
	Hard	.1726		0.195													
6	Easy	.1234	.0320	0.155	.0135	.0143	.0152	.0152	.0160	.0160	5.12	21.25	5.75	27.00	1⅛	4.73	6
	Medium	.1534		0.185													
	Hard	.1984		0.230													
8	Easy	.1480	.0431	0.191	.0190	.0201	.0213	.0223	.0235	.0235	5.12	28.25	7.25	35.50	1¼	6.53	8
	Medium	.1779		0.221													
	Hard	.2230		0.266													
10	Easy	.1733	.0553	0.229	.0251	.0265	.0278	.0292	.0306	.0319	5.12	45.50	7.25	52.75	1⅜	8.56	10
	Medium	.2033		0.259													
	Hard	.2483		0.304													
12	Easy	.1992	.0683	0.268	.0318	.0335	.0368	.0384	.0401	.0417	5.12	56.50	7.25	63.75	1⅜	10.84	12
	Medium	.2292		0.298													
	Hard	.2825		0.351													
16	Easy	.3132	.0950	0.408	.0470	.0515	.0537	.0581	.0624	.0647	5.12	107.00	28.00	135.00	1⅝	15.85	16
	Medium	.3524		0.447													
	Hard	.4300		0.525													
20	Easy	.4399	.1203	0.560	.0648	.0704	.0759	.0814	.0871	.0926	3 98	169.00	28.00	197.00	1⅞	21.14	20
	Medium	.4827		0.603													
	Hard	.5931		0.713													
24	Easy	.6429	.1600	0.803	.0852	.0952	.1019	.1085	.1188	.1253	3.98	242.00	28.00	270.00	2	28.33	24
	Medium	.7033		0.863													
	Hard	.8450		1.005													
30	Easy	.9630	.2003	1.171	.1204	.1329	.1453	.1536	.1708	.1830	3.98	423.00	28.00	451.00	2¼	37.32	30
	Medium	1.055		1.264													
	Hard	1.266		1.478													
36	Easy	1.277	.2783	1.555	.1569	.1770	.1969	.2168	.2331	.2527	2.20	764.00	28.00	792.00	2½	50.45	36
	Medium	1.400		1.678													
	Hard	1.680		1.958													
48	Easy	1.917	.5570	2.474	.2822	.3157	.3489	.3820	.4193	.4519	2 20	1,526.00	28.00	1,554.00	3	105.83	48
	Medium	2.100		2.657													
	Hard	2.517		3.074													

The price of the "**Providence Flush Hydrants**" is for each, including carting, $150.00. The price of 4-inch **Post Hydrants** (which are sometimes used fo special purposes) is for each, including gate, connection and carting, $55.00.

* The figures in this column allow for extra joints and an excess of 25 per cent. over the calculated weight.

† The figures in this column are necessarily approximate. The cost of specials in detail is given in Table No. 4.

TABLES FOR ESTIMATING THE COST OF LAYING CAST-IRON WATER PIPE.

TABLE NO. 4.

WEIGHT AND COST OF "SPECIAL" CASTINGS, ETC.

To be used in connection with Table No. 3 when greater accuracy with regard to "specials" is required.

Nature of "special" (in inches).	Length that "special" will lay.	Weight in pounds.	Cost at $.03 per pound.	Nature of "special" (in inches).	Length that "special" will lay.	Weight in pounds.	Cost at $.03 per pound.
Branches.	Feet.		$	Reducers.	Feet.		$
6 × 4	3.22	190	5.70	6 to 4	1.63	65	1.95
6 × 6	3.22	190	5.70	8 to 6	1.95	105	3.15
6 × 6 × 6	3.22	235	7.05	10 to 8	1.65	148	4.44
6 × 8	3.22	218	6.54	12 to 8	2.61	205	6.15
6 × 6 × 8	3.22	265	7.95	16 to 12	2.70	338	10 14
8 × 4	3.20	239	7.17	20 to 16	4.17	863	25.89
8 × 6	3.20	243	7.29	24 to 12	4.59	923	27.69
8 × 8	3.56	287	8.61	30 to 24	3.04	1158	34.74
8 × 8 × 8	3.20	362	10.86				
8 × 8 × 6	3.20	315	9.45	Turns.			
8 × 6 × 6	3.20	284	8.52	4—1-16	1.55	48	1.44
10 × 6	3.36	353	10.59	4—⅛	1.33	47	1.41
10 × 6 × 6	3.36	360	10.80	4—¼	1.89	61	1.83
10 × 8 × 6	3.36	426	12.78	6—1-16	1.58	90	2.70
10 × 8	3.36	356	10.68	6—⅛	1.42	92	2.76
10 × 8 × 8	3.36	446	13.38	6—¼	1.38	109	3.27
12 × 6	3.22	394	11.82	8—1-16	3.57	233	6.99
12 × 6 × 6	3.22	469	14.07	8—⅛	3.32	239	7.17
12 × 8 × 6	3.22	581	17.43	8—¼	2.25	136	4.08
12 × 8	3.22	428	12.84	10—1-16	3.48	291	8.73
12 × 8 × 8	3.22	481	14.43	10—⅛	3.23	296	8.88
12 × 10	3.39	535	16.05	12—⅛	3.22	443	13.29
12 × 12	3.22	453	13.59				
16 × 6	3.03	588	17.64	Bevel hubs.			
16 × 6 × 6	3.03	660	19.80	6	1.75	90	2.70
16 × 8 × 6	3.03	661	19.83	8	1.74	130	3.90
16 × 8	3.20	641	19.23	10	3.98	316	9.48
16 × 8 × 8	3.20	733	21.99	12	1.72	219	6.57
16 × 10	3.20	638	19.14				
16 × 12	3.20	627	18.81	Spig't caps			
16 × 12 × 12	3.20	800	24 00	6		39	1.17
16 × 16	3.29	845	25.35	8		57	1.71
20 × 6	4.84	1123	33.69	10		78	2.34
20 × 6 × 6	4.84	1202	36.06	12		110	3.30
20 × 8	4.84	1183	35.49	16		155	4.65
20 × 8 × 6	4.84	1190	35.70				
20 × 10	4.84	1112	33.36	Bell caps.			
20 × 10 × 8	4.84	1250	37.50	6		41	1.23
20 × 12	4.84	1233	36.99	8		63	1.89
20 × 16	4.84	1383	41.49	10		78	2.34
24 × 6	4.53	1082	32.46	12		118	3.54
24 × 6 × 6	4.53	1453	43.59	16		160	4.80
24 × 8	4.53	1345	40.35	20		220	6.60
24 × 8 × 8	4.53	1540	46.20	24		342	10.26
24 × 10	4.53	1463	43.89	30		548	16.44
24 × 12	4.53	1408	42.24				
24 × 16	4.53	1537	46.11	Plugs.			
24 × 24	4.53	1656	49.68	4		10	.30
30 × 6	5.04	1955	58.65	6		15	.45
30 × 8	5 04	1980	59.40	8		27	.81
30 × 8 × 6	5.04	2150	64.50	12		67	2.01
30 × 8 × 8	5.04	2145	64.35				
30 × 10	5.04	2078	62.34	Sleeves.			
30 × 12	5.04	2048	61.44	4		38	1.14
30 × 12 × 8	5.04	2210	66 30	6		56	1 68
30 × 16	5.04	2290	68.70	8		80	2.40
30 × 20	5.04	2288	68.64	10		107	3.21
30 × 24	5.04	2560	71.80	12		131	3.93
30 × 24 × 12	5.04	2695	80.85	16		207	6.21
30 × 30	5.04	2478	74.34	20		319	9.57
				24		457	13.71
Blow offs...				30		637	19.11
				36		907	27.21
24 × 6	4.53	1377	41.31				
30 × 8	5.04	2055	61.65	Gate boxes			
				Large "		689	20.67
Manholes...				" rings.		142	4.26
				" cov'rs		83	2 49
24	4.53	1625	48 75	Small box			
30	5.04	2020	60.60	(6")		137	4.11
36	4.00	2015	60.45	" cover (6")		19	.57
Hydrant		1010		" box (8")		160	4.80
Hydrant box		491	14.73	" cover (6")		38	1.14
Frame and cover		102	3.06				

NOTE TO TABLE NO. 1.

The thickness of the cast-iron pipes given in this table were calculated by the following formulas:

For diameters greater than 36 ins., $t = .00008\ H\ D + .0125\ D + .33$; for diameters of 36 ins. and less, $t = .00008\ H\ D + .01\ D + .36$; t = thickness in decimals of an inch; D = diameter in inches; H = head in feet.

NOTE TO TABLE NO. 3.

The figures under the head of **labor** include all work relative to the laying of the pipe and "specials," and setting gates and hydrants, etc., such as excavating and back-filling, laying and calking pipe, etc., blocks and wedges for pipes having diameters larger than 20 ins., carting pipes, specials and hydrants, etc., and cleaning up the streets after the work has been completed, and all other expenses generally incurred in ordinary water-pipe laying, which is not mentioned elsewhere in detail in the table.

The h's in the columns relating to the cost of pipe at $1.00 per ton indicate the greatest static pressure under which the pipe is to be used. The percentage of the cost of **specials** was based upon $0.025 with pipe at $30.00 per ton, and the cost of **air cocks,** which are included in this percentage for pipes having diameters larger than 20 ins. at $10.00 each.

The cost of lead was considered at $0.05 per pound and ordinary labor at $1.50 per day.

TABLE No. 5.

COST IN DETAIL OF LAYING WATER PIPE OF THE "PROVIDENCE PATTERN," INCLUDING EXCAVATING AND BACK-FILLING FOR THE SAME.

Excavation (Easy Digging).

Items.	Diameter in inches. 4	6	8	10	12	16	20	24	Average prices of labor, etc.
1 Trenching	.0422	.0518	.0611	.0707	.0798	.1445	.2088	.....	$1.50
2 Laying	.0129	.0162	.0191	.0219	.0249	.0370	.0497	.....	1.50
3 Foreman	.0130	.0158	.0188	.0216	.0244	.0303	.0360	.....	3.00
4 Tools, etc., etc	.0041	.0050	.0059	.0069	.0078	.0134	.0191	.....	7.4% of 1 and 2.
5 Calking	.0106	.0107	.0108	.0111	.0118	.0159	.0301	.....	$2.25
6 Lead	.0224	.0320	.0431	.0553	.0683	.0950	.1203	.....	5c. per pound.
7 Teams	.0070	.0090	.0115	.0136	.0160	.0203	.0216	.....	$2.25
8 Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.....	$1 per ton.
Total	.1200	.1554	.1911	.2286	.2676	.4062	.5602	.....	

Cost of Easy Digging reduced to $1 and 1c.

Trenching	.0281	.0345	.0407	.0471	.0532	.0963	.1392	.....	$1.00
Laying	.0086	.0108	.0127	.0146	.0166	.0247	.0331	.....	1.00
Foreman	.0043	.0053	.0063	.0072	.0081	.0101	.0120	.....	1.00
Tools, etc., etc	.0006	.0007	.0008	.0009	.0011	.0018	.0026	.....	1%
Calking	.0047	.0047	.0048	.0049	.0052	.0071	.0134	.....	$1.00
Lead	.0045	.0064	.0086	.0111	.0137	.0190	.0241	.....	.01
Teams	.0031	.0040	.0051	.0060	.0071	.0090	.0096	.....	1.00
Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.....	1.00

Excavation (Medium Digging).

1 Trenching	.0507	.0697	.0790	.0883	.0974	.1700	.2400	.3091	$1.50
2 Laying	.0189	.0220	.0249	.0279	.0307	.0440	.0577	.0639	1.50
3 Foreman	.0180	.0206	.0234	.0265	.0294	.0350	.0373	.0396	3.00
4 Tools, etc., etc	.0056	.0065	.0075	.0084	.0093	.0154	.0214	.0002	7.2% of 1 and 2*
5 Calking	.0106	.0107	.0108	.0111	.0118	.0159	.0301	.0757	$2.25
6 Lead	.0224	.0320	.0431	.0553	.0683	.0950	.1203	.1600	5c. per pound.
7 Teams	.0070	.0090	.0115	.0136	.0160	.0203	.0216	.0228	$2.25
8 Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.1317	$1 per ton.
Total	.1500	.1854	.2210	.2586	.2975	.4474	.6030	.8630	

Cost of Medium Digging reduced to $1 and 1c.

Trenching	.0331	.0465	.0527	.0589	.0604	.1133	.1600	.2061	$1.00
Laying	.0126	.0147	.0166	.0186	.0205	.0293	.0385	.0426	1.00
Foreman	.0060	.0069	.0078	.0088	.0098	.0117	.0124	.0132	1.00
Tools, etc., etc	.0008	.0009	.0010	.0012	.0013	.0021	.0030	.0037	1%*
Calking	.0047	.0047	.0048	.0049	.0052	.0071	.0134	.0336	$1.00
Lead	.0045	.0064	.0086	.0111	.0137	.0190	.0241	.0320	.01
Teams	.0031	.0040	.0051	.0060	.0071	.0090	.0096	.0101	1.00
Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.1317	1.00

Excavation (Hard Digging).

1 Trenching	.0860	.0959	.1053	.1147	.1300	.2261	.3264	.....	$1.50
2 Laying	.0271	.0303	.0333	.0362	.0411	.0530	.0669	.....	1.50
3 Foreman	.0290	.0286	.0314	.0343	.0372	.0428	.0452	.....	3.00
4 Tools, etc., etc	.0081	.0090	.0099	.0109	.0118	.0201	.0283	.....	7.2% of 1 and 2
5 Calking	.0106	.0107	.0108	.0111	.0118	.0159	.0301	.....	$2.25
6 Lead	.0224	.0320	.0431	.0553	.0683	.0950	.1203	.....	5c. per pound.
7 Teams	.0070	.0090	.0115	.0136	.0160	.0203	.0216	.....	$2.25
8 Carting	.0078	.0149	.0208	.0275	.0346	.0513	.0746	.....	$1 per ton.
Total	.1950	.2304	.2661	.3036	.3508	.5250	.7134	.....	

Cost of Hard Digging reduced to $1 and 1c.

Trenching	.0573	.0639	.0702	.0765	.0867	.1507	.2176	.....	$1.00
Laying	.0181	.0202	.0222	.0241	.0274	.0353	.0446	.....	1.00
Foreman	.0087	.0095	.0105	.0114	.0124	.0143	.0151	.....	1.00
Tools, etc., etc	.0011	.0013	.0014	.0015	.0016	.0028	.0039	.....	1%
Calking	.0047	.0047	.0048	.0049	.0052	.0071	.0134	.....	$1.00
Lead	.0045	.0064	.0086	.0111	.0137	.0190	.0241	.....	.01
Teams	.0031	.0040	.0051	.0060	.0071	.0090	.0096	.....	1.00
Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.....	1.00

* The percentage for 24-inch includes blocks and wedges, and is 16·1%.

This table contains the items in detail, from which the cost of the labor of laying water pipe, from 4 to 24 in. in diameter, given in Table No. 3, were obtained.

The word "Trenching" is used for excavating and back-filling.

Throughout these tables **Easy Digging** is intended to correspond to excavation in sand, etc.; **Medium Digging** to excavation in sand and gravel, etc.; and **Hard Digging** to excavation in hard or moist clay, etc. The figures relating to medium excavation are probably the most reliable for pipes that have a diameter greater than 8 ins.

The prices given in any of the tables do not include the cost of engineering and inspection.

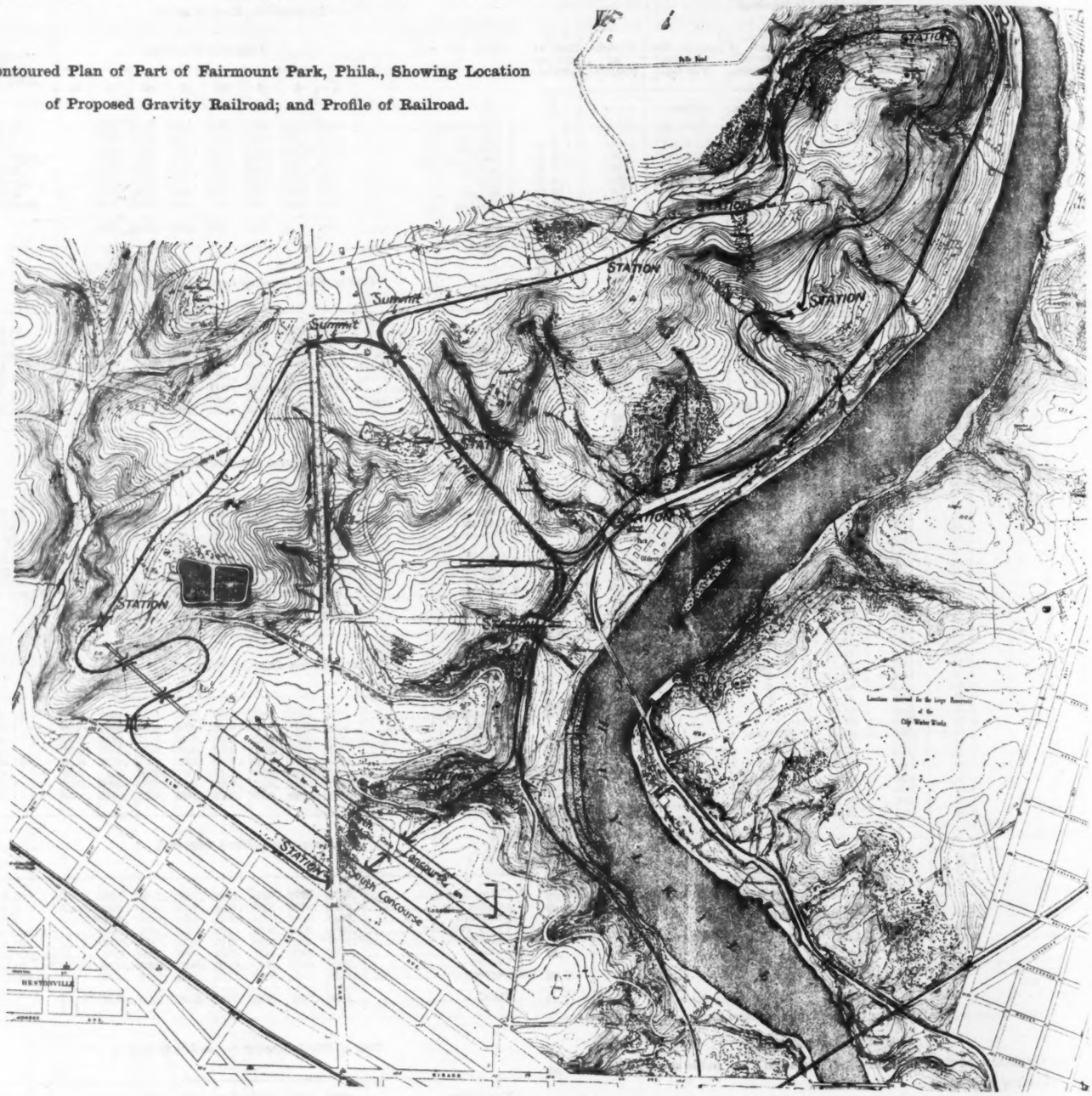
(To be continued.)

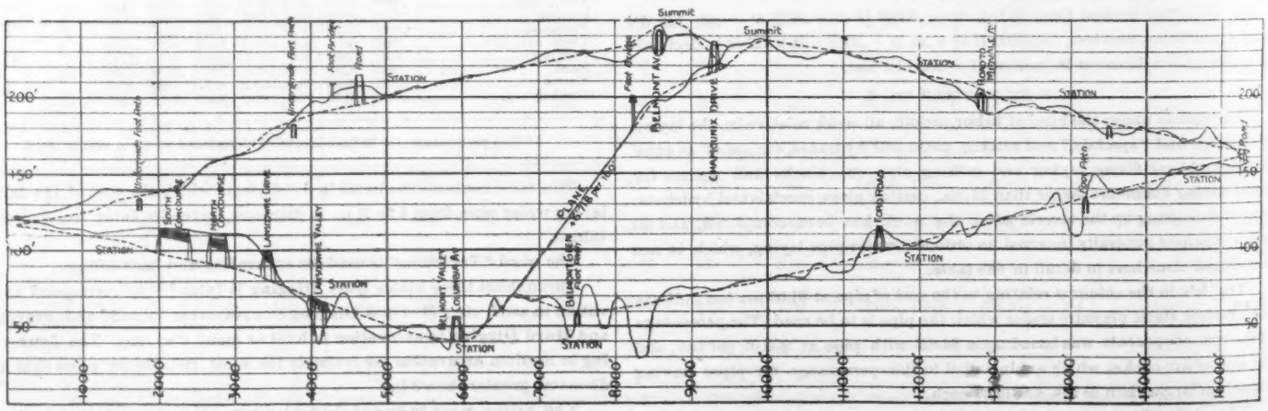
The Proposed Gravity Railroad in Fairmount Park, Philadelphia, Pa.

The gravity railroad here shown was first proposed in 1870, by Mr. SAMUEL L. SMEDLEY, Chief Engineer and Surveyor of Philadelphia; but after lying dormant for many years, the scheme has been revived by Mr. WILLIAM WHARTON, Jr., of Philadelphia, who has obtained permission from the Fairmount Park Commission to build and operate the road. Mr. CHARLES G. DARRACH, of the firm of Wilson Bros. & Co., of Philadelphia, is the present Chief Engineer of this work, and to him we are indebted for the plan and profile here given, and also for the following general description.

The railroad, including the double track on planes, has a length of eight miles. As shown on the accompanying drawings, it encircles the West Park,

Contoured Plan of Part of Fairmount Park, Phila., Showing Location of Proposed Gravity Railroad; and Profile of Railroad.





and brings into view the scenery along the Schuylkill River, as well as the varying topography of the entire park and the greater party of the city of Philadelphia.

The summit of the railroad, 245 ft. above the Schuylkill River, is near the crossing of Belmont Ave. with Boundary Ave., and within easy walk of the Gentlemen's Driving Park. From this point the line crosses over Belmont Ave. with an arch bridge, and runs southwestwardly along Boundary Ave. to the hill slopes of George's Run; thence, passing, under the park drive, to and around the point of George's Hill, first taking a northeastwardly and then a southwestwardly course, it descends the eastern slope of George's Hill, and passing under the road to the Catholic Total Abstinence Fountain, it reaches Elm Ave.; thence southeastwardly parallel with Elm Ave. to a point near Belmont Ave., where it curves to the left; thence taking a northeastwardly course to the foot of the plane near the Belmont Water Works. From the point of leaving Elm Ave. it crosses with tunnels under Belmont Ave., the South Concourse, the North Concourse and the Lansdowne Drive, and with an iron trestle over Lansdowne Valley to the river hills; thence crossing under Columbia Ave. with a bridge, to foot of plane. The distance traversed from the summit to foot of plane by gravity on the line described is 14,719 ft.

The elevation of the summit is 250 ft. above City Datum. The entire fall from the summit to foot of grade is 210 ft., making foot of grade 35 ft. above the water in the river. At the foot of grade the cars will be drawn by a motor up the plane, passing Belmont Mansion and under Chamounix Drive, a distance of 4,143 ft. to a secondary summit, having an elevation of 237 ft. above the river, and about 800 ft. west of the first summit mentioned. This line describes what is called the South Circuit, and is 18,862 ft. or $3\frac{5}{10}$ miles in length.

From the secondary summit, the line commences to descend on the North Circuit, and running in a northeastwardly direction it follows the northern boundary of the park along the Gentlemen's Driving Park; thence following the side hill looking into Chamounix Valley, crossing over drive to Midvale Ave. and the drive to Mount Prospect, it passes around the outside of Mount Prospect to the steep slopes of the Schuylkill River valley; thence southwestwardly passing under the new Ford Road to the foot of grade at Belmont Glen, a distance of 14,800 ft., the fall from summit to this point being 177 ft. At the foot of this grade the cars will again be taken by a motor up the plane to the first summit mentioned, rising 190 ft. in a distance of 4,700 ft. The length of line on the North Circuit is 19,500 ft., or $3\frac{7}{10}$ miles; making the entire length of line traversed by the cars, $7\frac{3}{10}$ miles. The motors, after they have taken the cars from foot to summit of plane, return on a separate track to the foot of grade.

The minimum radius of curvature on main line is 190 ft., and on motor siding 154 ft. The maximum gradient on main line is 3 ft. per 100 ft. The minimum gradient on main line is .7 ft. per 100 ft. The maximum gradient on loaded track on plane is 6.718 ft. per 100 ft., and on the empty motor track siding 8.843 ft. per 100 ft. (with the traffic).

The only grade crossing on the entire line is where the empty motor track crosses the loaded track near the summit of the plane. All other crossings of either railroad—drives or walks—are by bridges, tunnels, or trestle work.

It is proposed to make the railroad crossings of Belmont Ave., near the summit, and of the drive to Midvale Ave., of brick and masonry arches, faced with Pompeian terra cotta; the other bridges to have floors of brick laid in cement, supported on iron I-beams with stone masonry abutments. The tunnels are to be constructed of stone masonry abutments, with brick arches.

It is proposed to locate passenger stations as follows: At Belmont Mansion, George's Hill, Elm Ave., corner of Belmont Ave., point of hill opposite mouth of Lansdowne Ravine, foot of the grade of South Circuit opposite Belmont Water-Works, foot of grade of the North Circuit near the mouth of Belmont Glen opposite the passenger station of the Reading Railroad, a point near crossing of Ford Road, Mount Prospect, a point near the junction of the Chamounix Drive with the Ford Road, a point near the eastern end of Gentlemen's Driving Park.

It may interest the general reader to know that the plane frequently referred to in this paper is the old inclined plane of the Penna. State railroad, or Philadelphia & Columbia R. R. This plane, as used in 1832, was 2,805 ft. long and 187 ft. in height, and was operated by stationary engines. Its position is plainly indicated on the contoured map just west of the Columbia bridge over the Schuylkill.

Experiments on the Efficacy of Filtration Through Sand.*

In the early months of 1889, Berlin was visited by an epidemic of typhoid fever which extended over a wide area, and which, from the middle of January to the middle of April, caused some seven hundred cases to come under the notice of the authorities. By reference to a map it is shown that this outbreak must have been wholly unconnected with the levels of the sub-soil water, as in lieu of extending over a district parallel with the course of the river, which would follow the lowest levels of the sub-soil water, it took a direction exactly the opposite, and attacked the western portions of the town, leaving the east end of Berlin untouched. For this reason the water-supply became suspected, and VIRCHOW, at the meeting of the Berlin Medical Society on the 19th June, pointed to this as a possible cause of the epidemic. The authors mention several matters which may have contributed to the evil. The water-works near the Stralau Gate, possesses eight open, and three covered filtering-beds. During the long-continued frosts of the winter months the open basins become frozen over, and in time become useless, so that the whole of the effective filtration has to be carried out in the three covered basins, which in consequence are worked at far too great a pressure. Thus, in February last, a rise in working speed took place of from 130 m. m. to 160 m. m. per hour, and on the 12th of March the maximum rate of filtration of 224 millimetres per hour was attained. The formation of a layer of bacteria on the surface of the sand is found to greatly retard the rate of filtration, and when the head of water is increased, it tends to drive the micro-organisms through the pores of the filtering material, and ultimately into the filtered water. This state of things is, of course, attained all the more quickly when the water to be filtered is very impure. The number of germs rose rapidly from about 100 in the middle of January to over ten times the amount in February, and attained, during March, the enormous total of upwards of 4,000 per cu. cm. At the beginning of April, when the whole of the filter-beds were again in operation, the numbers of germs at once sank to the normal level. During these months the waters of the Spree were highly charged with bacteria, the numbers of germs, from January to March, often exceeding 100,000 per cu. cm. Though the presence of typhoid germs has not been demonstrated therein, the water-supply of Berlin was manifestly extremely impure.

Much suspicion was expressed respecting this state of things, and the authors were commissioned by Mr. KOCH to investigate whether it might be possible to spread the germs of infectious diseases through the mains of the water company. For this purpose they undertook a series of experiments, all the necessary assistance being given to them by the company. It has hitherto been assumed by experts that the sand filter, carefully and properly managed, yields a germ-free, hygienically perfect filtrate. If this theory were thoroughly sound, investigations of the character of those here recorded would have been useless, but it soon became evident that complete experiments touching the fate of pathogenic micro-organisms, passing through the sand filter had not hitherto been attempted. It was manifestly out of the question to make a trial of the filter-basins themselves, as even if it were possible to procure the large stock of bacteria needed for the experiments, the danger of infecting such vast quantities of water, and the need of carrying out observations over so wide an area, would present unsurmountable difficulties. It was therefore decided to employ small sections of the actual filter-beds. Two tubs were used, each 2.1 m. (6.7 ft.) high and 0.75 m. (2.5 ft.) in mean diameter, at whose base was a sieve-like connecting channel. The filtering material was disposed in these tubs in the same thicknesses as in the actual section of the beds, viz., 100 m. m. (3.9 ins.) of pebbles of the size of hazel nuts; 80 m. m. (3.1 ins.) of coarse gravel; 100 m. m. (3.9 ins.) of fine gravel, and 600 m. m. (2 ft. nearly) of fine sand. The surface of this sand was about 1.2 m. (4 ft.) below the top of the vessel, which was provided with an overflow-pipe.

The outlet-pipe from the filters was curved upwards to above the level of the sand, and the inlet-pipe was adjusted to supply the water at any given rate. It was thus possible to work the filters at the required speed, and to avoid all disturbance of the contents. Having completed all these preparations, and formed two distinct filters, the authors were enabled to commence their observations, and they deemed it advisable to study, in the first instance, the behaviour of a bacillus of a non-dangerous character and of strongly marked features, and for this purpose the *bacillus violaceous* was selected. It was cultivated in very dilute nutritive bouillon, so as to render it impossible for the bacteria, when they were exposed to the still further dilution in the filter, to find the requisite supplies of food-stuff. This liquid, which had a pale bluish tint, was added every six hours to the contents of the unfiltered-water reservoir, in quantities of about 100 cu. cm. at a time. Samples were taken daily for bacteriological examination, both of the unfiltered and of the filtered liquids, and they were cultivated on gelatin plates in the usual way. The filters were worked, the one at the rate of 300 m. m. (11.8 ins), the other at the rate of 100 m. m. per hour.

The results were set forth in tabulated form, and prove that, throughout the whole period of observation, the bacteria passed through the filter, the numbers being in general accordance with the rate of filtration. About three times as many colonies were formed in the former filtrate as there were in the latter. When the speed of filtration was reduced in the second filter to 50 m. m. per-hour, the relative abundance of the colonies of blue bacteria was about as 6 to 1. The proportion of the blue bacteria in the unfiltered water to those in the filtrate was, roughly speaking, 1,000 to 1. The slower rate of filtration produced, unquestionably, the better results. Similar experiments with cholera and typhoid fever bacteria gave corresponding results, and the authors conclude that the sand filter is not a germ-proof apparatus, and is incapable of retaining the spores of the ordinary water-bacteria, as also those of a pathogenic character. The number of germs passing through the filter are in proportion to those in the unfiltered liquid, and in accordance with the speed of filtration. Both at the beginning and at the end of each periodic use of the filter, there is an interval of danger when the germs pass through the beds in greater abundance.

*By Dr. CARL FRANKEL and C. PIEFKE in *Zeitschrift fur Hygiene*, vol. viii., 1890, p. 1, Abstract of Papers, Inst. C. E.

The Highway Bridge of the Future.

We are indebted to Prof. J. A. L. WADDELL for the following interesting example of the effect of permitting go-as-you-please contests for highway bridge designs and contracts. A Mr. C. G. DIBBLE, of Farmington, Ia., has invented the highway bridge shown in the accompanying illustration. It is introduced to the attention of bridge builders in the following little notice, which we republish free:

WANTED, BRIDGE BUILDERS ON ROYALTY.

If a man can run, jump, whip, eat or lift more than any other man, he has a record. And if a bridge will bear more weight with two-thirds expense and same amount of material, on an entirely new plan, it will get there, too. For full particulars apply to H. L. DIBBLE.
Farmington, Ia.

Having thus introduced his "entirely new plan," Mr. DIBBLE continues in the following circular, which we reprint *verbatim*, to explain his ideas more at length. The circular will bear careful reading. We italicize some specially novel points, but the whole is worth study. The painful thought cannot but arise: What are the probable consequences of allowing cranks like this to urge their projects on the attention of county commissioners and "underbid other builders" without any control by the law?

Feb' 12, 1884. C. G. DIBBLE, Farmington, Iowa, invented and had patented an improvement in bridges No. 293,427.

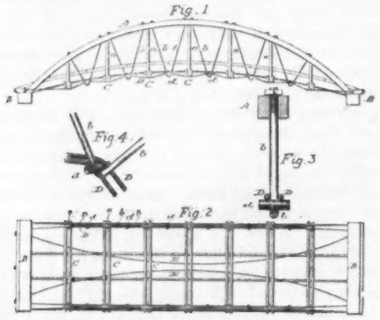
His health, age and limited finance prevented introducing it more extensively to the public. He had one bridge built near this place under his supervision 60 ft. long, width 14 ft. from out to out. Arches were elevated in highest places 4¼ feet above the track and composed of 2-in. plank over the top of the posts.

The arches contained 1,200 feet lumber.
Stringers on which floor rests 500 feet.
Floor of wagon track 1,280 feet.
Posts 150 feet.
Cross timbers 500 feet.

Total 3,630 @ $20 per 1,000	$ 72.60
The underlaying chords of this bridge instead of being wire cables were round iron and cost at 3¼ cents per pound	49.00
The castings at the foot of the arch	10.00
Smith work	25.00
Put up	37.00
Total cost	193.60
For which he received from county	450.00
Net. profit	256.40

And underbid other builders and gave privilege of testing it with 30 tons. But the second year high water washed one pier away and it went out. The bridge was a success. Please refer to any of our citizens as to this statement.

Enclosed find two photographs, one representing a side elevation ,the other a platform or wagon track. *Unlike other bridges, the whole strength of the structure depends upon the number and direction of the underlying cables and chords,* in passing from end to end, *while the arch is merely to give rigidity to the structure.* There should be two wire chords, or round irons will answer the purpose, under each arch. If suffered to drop, these chords would form an inverted arch drooping nearly as far below the track as the arch is elevated above. The slack should be taken up by the V-shaped iron rods passing through the arch and secured by screws. To adjust a bridge, these nuts should be turned until the track has proper camber. You will see this process gives the chords an undulating direction alternately up and down from end to end, effectually prevents all vertical vibration, while the load is passing. The arch in a 60-ft. span should not be



Dibbles "Highway Bridge."

elevated in the center to exceed 4½ ft. above the track. and *need not be more than half as heavy as an old fashioned arch bridge, where the whole strength depends upon the arch.* The platform representation shows the cross timbers which should be about 2 ins. thick and 12 ins. wide for an 80 ft. span and bolted at the foot of the upright posts, the posts passing between them. The curved lines represents chords starting near the foot of the arch, diverging to the center of the bridge and return to the same side, forming a circle. *These chords serve as main chords and can be multiplied to any extent to hold up any amount from 100 to 1,000 tons,* while they effectually prevent all lateral vibration.

It is so constructed that every piece of timber may be removed and new substituted, while teams are crossing. It is gotten up on scientific principle and will so prove itself when brought into use. *It is a combination of the wire cable, suspension and ordinary arch,* and when adjusted as represented *it is the strongest structure that can be composed of wood or entirely of iron, with same amount of material. It is perfectly rigid.* Heat and cold can not *effect* it. Each chord, brace and timber *are* at all times doing its part. *It has no dead weight to overcome.* We wish to introduce this by having you build one bridge. If it proves as represented we will take a royalty of 50 cts. per lineal foot of bridges built in your county. We had a wood cut. It was altogether out of proportion, so had this photo taken from a model 25 ins. long, weighing 1½ lbs., and testing 500 lbs., and 33 per cent. less cost than the truss bridge. If you are not situated to handle this, please present to some party interested in this line of business.

Prof. Vose (himself a friend of high bridges) in his recent work, "Bridge Disasters in America," admits that over 100 high bridges fall in this country every year. Address, H. L. Dibble, Farmington, Iowa.

Tests of Paving Brick.

The following tests of paving brick, for absorption, resistance to impact, crushing strength and specific gravity were made by Mr. W. G. Potter, of the class of '90, University of Wisconsin, who has kindly sent them to this journal.

The first table shows the results of tests for absorption in paving brick of six manufactures. The bricks were first weighed and then laid in a tank of water, their weights being taken again at the end of one hour, one day and one week. The bricks were not subjected to any drying operation before the test, but were kept in a warm room for some time previous to the test. A few building and fire brick were also tested for purposes of comparison.

TABLE I.
ABSORPTION TESTS.

Number of brick.	Place of Manufacture.	Average weight before immersing.	Average gain in weight. In one hour.	In one day.	In one week.	Remarks.
		Pounds.	Per cent.	Per cent.	Per cent.	
3	Montserrat, Mo..	5.719	0.73	1.1		Top course brick.
4	Lincoln, Neb.....	5.404	1.1	1 6	2.1	Bottom course brick.
4	" "	5.328	1.4	3.4	4.8	
6	Galesburg, Ill....	5.34	0.8	2.35	3.8	
5	" "	5.35	0.5	1.8	3.4	Same as above with one brick omitted.
6	Beatrice, Neb.....	5.58	5.9	7.5	7.9	Much mottled, pebbly.
8	Ottawa, Ill	16.88	0.3	2.0	3.4	Vitrified blocks.
2	Haydenville, O...	9.15	0.15	0.7	1.65	Hayden blocks, vitrified.
3	" " ...	17 04	0.5	0.85	1.7	" double "
1	.....	5 56	10.7	11.9	12.4	Red pressed building brick.
1	.....	4.40	13.6	16.0	16.6	Common cream building brick.
1	Madison, Wis....	4.20	22.3	23 3	24.4	Poor " " "
2	.....	6.98	6.7	7.6	8.6	Fire brick.

The first four in the list are hard burned, regular size bricks, while the others vary in size and shape and are vitrified on the surface.

In the test for resistance to impact the bricks were placed in an iron "tumbling" box, 2 ft. 4 in. long and 1 ft. 5 ins. in diameter, inside measurements, and revolved at the rate of 15 revolution per minute for 30 minutes.

The brick were tested a few at a time with the box nearly filled with cast iron scrap. The results are as follows:

Table II.—Test for Resistance to Impact.

No. of brick.	Place of manufacture.	Weight before testing.	Loss of weight. Lbs.	%	Remarks.
		Lbs.	Lbs.	%	
1.....	Montserrat, Mo.	5.60	.085	1.5	Mottled.
3.....	Lincoln, Neb....	5 55	.08	1.44	Top course.
3.....	" " ...	5.33	.072	1.35	Bottom course.
3.....	Galesburg, Ill ..	5.40	.073	1.35	
3.....	Beatrice, Neb...	5.58	.095	1.70	Mottled.
3.....	Ottawa, Ill. ...	18.24	.159	0 87	Block.

In the compression, or crushing strength tests, a 50,000-lb. Tinius Olsen machine was used and, therefore, the brick could not be tested whole. They were broken approximately in the middle and trimmed off square. On account of the small inequalities on the faces and edges of most of the brick, however, the results can only be approximately correct. Brick for compressive tests should be faced preferably with plaster of Paris; but on account of lack of time this, and the grinding down of the edges, was not practicable.

The half brick were placed on edge in the testing machines. The results are as follows:

TABLE III.
TESTS FOR CRUSHING.

Number of half brick.	Place of manufacture.	Specific gravity.	Compressed face. Approx. length.	Width.	Depth.	Average of spalling. lbs.	Average of crushing. lbs.	Aver. strength per sq. in. lbs.	Remarks.
6	Montserrat, Mo...	2.382	3¾	2⅜	3¾	8,017	18,547	2,121	
5	Lincoln, Neb.....	2.376	4	2¼	3½	15,842	38,514	4,412	Top course, very uniform material.
	" "	....	3¾	2¼	3½	13,205	31,512	3,811	Bottom course, very uniform material.
4	Galesburg, Ill.....	2.421	3¼	2¼	3¾	11,275	39,276	4,903	Very uniform material.
3	" "	2.417	...	...	...	11,700	44,502	5,464	Same as above but omit. one specimen.
6	Beatrice, Neb.....	2.308	3¾	2⅜	4	17,455	31,462	3,546	
2	.....	2.379	4	2⅜	4	.....	43,970	4,714	Pressed building brick.
2	.....	2.239	3½	2⅜	3¾	.....	36,025	4,336	Good common brick.
2	Madison, Wis.....	... .	3½	2½	3¾	.....	11,595	1,265	Poor common brick.

In this test the column of lengths is only approximately averaged. Specific gravities were also found from pieces of the crushed brick, with no allowance for absorption, as that would be very small, and would not practically effect the result. Almost all breaks began by the harder burned exterior scaling off in large pieces, the interior being largely reduced to small pieces, and even powder.

Who Should Own the Water Meter; the Company, Department or Consumer?

At the late Chicago Convention of the American Water-Works Association, Mr. J. H. Decker, the then President of that body, read a paper with the above title; an abstract follows:

At the previous convention, Mr. Darling had presented a paper advocating the ownership of meters by the city or town; Mr. Decker was requested by some of the members to take the opposite side of the question, and to do so intelligently he sent out the question to 12 municipal works, 12 managers of private corporations, and to 12 engineers of reputation and experience, but not directly connected with the management of works.

Mr. Decker appends the replies received by him in full. In analyzing these he found the doctors to disagree widely. Of 10 engineers of municipal works, 7 advocated municipal ownership and 3 ownership by the consumer; of 9 managers of private water corporations, only 2 favored the consumer as owner; 8 disinterested hydraulic engineers were unanimous in department or company ownership. But while ownership by the consumer seems to be much in the minority, Mr. Gray, of Providence, R. I., a city using 8,000 meters, or more than any other city in the country, thinks the consumer should own the meter, because he is more apt to protect it from frost and accident and keep it in repair; he will learn to read it and watch for leakage on his premises; it seems best to give the consumer the choice between meters and fixture rates, and finally the consumer pays for the meter in any event, when used, by direct or indirect taxation. On the other hand, the manager of a private corporation with over 6,000 consumers, but without a single meter, favors department ownership.

In many cases the arguments used are identical for both sides of the question; the "facility with which renewals and repairs are made," figures as an argument for both department and consumer ownership. Others argue that the meter is and should be considered part of the plant; though Mr. Decker thinks that the same argument might be extended to the corporation cock, service and curb stop, all of which are more intimately connected with the plant than the meter. The argument that company or department ownership offers greater advantages in the way of care of meters, repairs, renewals, etc., is doubtless true; but the same premises are equally correct in the ownership of pipe, hydrants, faucets and every other household fixture. Were they all the property of the water company or department and cared for as we expect meters to be cared for there would be no wrangle with the consumer in regard to leaking fixtures and waste of water, and consequently there would be no necessity for the meter at all.

The meter, when placed upon the service of a consumer, is there for his exclusive use, just as are his service pipes, etc., and it becomes a part of the consumer's individual system of supply. It should there-

fore, says Mr. DECKER, be paid for and maintained by the consumer. The general rule obtains with water suppliers that they furnish the water to the consumer at the main pipe in the street, from which point it is conveyed by the consumer, in pipes laid at his expense, to such point as he may desire, and such fixtures are attached as best meet his requirements. Over all of this the water company exercises a control, vested in it by the laws of the state under which it is incorporated; whether the company is a private one acting under a franchise, or whether the supply is under municipal control. The supplying corporation has the right to demand that these fixtures, pipes, etc., be of standard and approved make, and that they shall be kept in proper repair, under penalty of refusing to furnish water through them.

The consumer having the meter is the party directly benefited; for by its use, in 90 cases out of 100, his water-rate will be from 25 to 50% less than under ordinary tariff rates. For example, an average dwelling of 7 or 8 rooms, with bath, lavatory and closet, is ordinarily rated at from $15 to $20 per annum. Assuming such a dwelling to be occupied by 6 or 7 people the maximum quantity of water actually used will be less than 100 galls. per day, or about 30,000 galls. per annum. This quantity, at 35 cts. per 1,000 galls., will aggregate $10.50 per year. The average rate for a house is $2 per year, and 8 galls. per day, or $1 worth of water per year, will serve in many cases. This same ratio of meter to schedule rates holds good through the tariff sheet, unless there be persistent and wilful waste. It is, in fact, only to prevent such waste that meters are ever demanded by the water department.

In Mr. DECKER'S opinion the consumer should pay the cost of the meter and setting and all subsequent repair; but the supplier should have full and indisputable control and the right to dictate the kind and size of meter to be used, and to regularly test it for accuracy. As a matter of policy the supplier should adopt certain standards of make and permit none other to be used. The supplier should purchase all meters direct from the manufacturers and set them, charging the consumer only *net cost*. "This will prevent the intermeddling of the plumber, who as a rule does not furnish anything, except at a profit, if he knows it."

It is also well for the company or department to keep a limited number of meters for rent, charging an annual rental of at least 25% of the cost of meter and setting. This action would meet the class of migratory consumers found in every community. Every meter should be made with all parts interchangeable, and be so constructed as to be easily and quickly repaired *in situ*. The company should, of course, keep in stock duplicate parts.

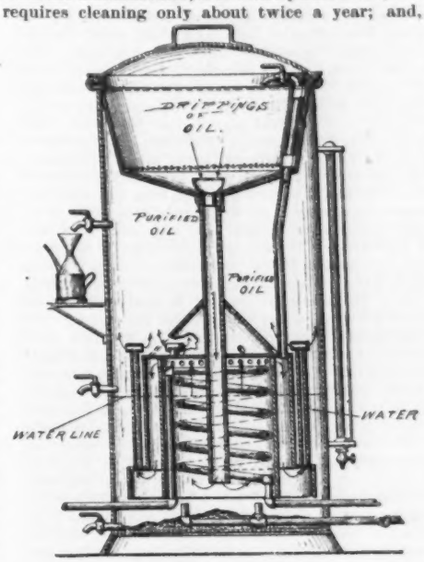
The rule at the water-works under Mr. DECKER'S charge is that when the consumer desires the meter the privilege is granted of setting it at his own expense, provided he will agree to pay a minimum rate. But when the company is satisfied that there is wilful waste or fraudulent use of water, a meter is placed on the premises and rental charged. The present practice of Mr. DECKER is, charge for a ⅝-in. meter, 50 cts.; ¾ or 1-in., 75 cts.; 1¼-in., $1.00 and larger sizes in like proportion.

A Lubricating Oil Purifier.

The fact that lubricating oils range in price from 25 cts. to $1.25 per gallon, with 50 to 65 cts. as an average, and the further fact that they all contain more or less dirt and grit, make a system of purification essential and the ability to clean and reuse oil that has already been run to waste, a telling economy.

This is the purpose of the purifier here shown. It is outwardly a galvanized iron tank about the size of the ordinary oil-tank used in engine rooms. The internal arrangement is well shown in the cut. In use, water is first put into the pan above, and sinks through the central tube, and covers the bottom of the tank to the depth of several inches; steam is turned on and the water heated. Oil is then put into the pan above, and, descending the central tube, passes up through the heated water around the steam coil and then through two other cylinders of water before it escapes to the top ready for use.

Among the advantages cited are these: Speed in purification; in winter the oil is kept warm; as the oil is perfectly clean, a less amount will do the work; waste oil, black with dirt, comes out purer than from the manufacturer; it is entirely automatic, and requires cleaning only about twice a year; and,



An Oil Purifying Tank.

finally, it is economical, and much more so than any ordinary filter system requiring renewal of charcoal, cloth, waste or felt. It is already in very extended use. The manufacturers are Barrows & Bliss, 806 Walnut St., Philadelphia, Pa.

PERSONALS.

Mr. H. M. DUFFIELD has been appointed a water commissioner of Detroit, Mich., vice J. S. Farrand.

Mr. L. H. CRAMER has been appointed surveyor and engineer of Saratoga Springs, N. Y., for the ensuing year.

Mr. JOHN W. TAYLOR, at one time connected with the Raritan Water-Works, died June 7, at Somerville N. Y.

Mr. JAMES REYNOLDS, Roadmaster of the Cleveland, Loraine & Wheeling R. R., died at Ravenna, O., June 13.

Mr. THOMAS BARRETT, a bridge contractor of Knoxville, Ia., was instantly killed near Swan, June 11, by a pile from a bridge falling on his back.

AT a recent meeting of the General Passenger Agents Association at Chicago, Mr. J. F. GODDARD was unanimously elected permanent chairman.

Mr. O. W. STAGER has been appointed master of transportation of the Philadelphia & Reading road, with headquarters at Philadelphia, vice A. J. SPEESE, resigned.

Mr. D. MCN. STAUFFER sailed by steamer *City of New York*, on Wednesday, June 18, for an extended tour through Turkey and Russia. He will return about Sept. 17.

Mr. H. L. HIGDON, formerly chief engineer of the Austin & Northwestern R. R., and lately connected with the Wichita Valley R. R., died at Lampasas, Tex., June 11.

Mr. WM. T. GOULD has resigned his position in connection with the Mobile & Ohio R. R. to accept a position as resident engineer of construction on the Northern Pacific R. R.

Mr. PHILIP GOLAY, has been appointed resident engineer in charge of the Government locks and dams on the Monongahela River, with headquarters at Morgantown, W. Va.

Major CLARKE, City Engineer of Syracuse, N. Y., was presented with a gold badge of the Fifth Army Corps, at the reunion of the 185th Regiment, held at Homer, N. Y., June 11.

Mr. F. MEREDITH JONES has left the Southern Mexican Railway and taken a position as chief engineer of the Vera Cruz Land & Colonization Co., with headquarters at Mizantla.

Mr. L. S. WAKEFIELD, of the firm of Wakefield, Hill & Wingsland, Civil Engineers, of Sioux City, Ia., has been appointed Chief Engineer of the Pacific Short Line R. R., vice S. H. CLARK, resigned.

MR. H. C. LITCHFIELD, A. M. I. C. E., one of the engineers in the 1887-8 Nicaragua Ship Canal Expedition, has been appointed District Engineer at the Kimberley-Bechuanaland Railway, South Africa.

Mr. EDWARD DICKINSON, General Manager of the Missouri Division of the Union Pacific, has tendered his resignation, to take effect July 1. Mr. DICKINSON'S connection with the road extends over a period of twenty years.

Mr. W. J. C. KENYON, formerly general passenger agent of the Burlington & Northern R. R., has been appointed general freight and passenger agent of the Chicago, Burlington & Quincy R. R., with headquarters at St. Paul.

Mr. W. B. BRIMSON, formerly trainmaster on the Lake Erie & Western road, later on the Chicago & Eastern Illinois, has been appointed superintendent of a system of roads, of which the Milwaukee, Bay View & Chicago forms a part.

Chief Engineer A. S. GREENE, U. S. N., has been detached from duty at Chicago, Ill., and ordered to special duty connected with the water-works at Hot Springs, Ark. Commander A. D. BROWN has been granted leave of absence for one year.

Mr. J. O. BRINKERHOFF, superintendent of the Kansas division of the Union Pacific R.R., has been appointed general manager of the Missouri division of that road, which includes the lines from Kansas City to Denver, Omaha and Cheyenne.

Mr. LEO G. BROWN, a member of the Colorado River Cañon Exploring Expedition, under Mr. ROBT. B. STANTON, died June 10, at his father's residence in Chillicothe, of brain fever, supposed to have been brought on largely by exposure. He was in his twenty-third year.

Mr. JOHN J. HOPPING, an influential citizen of Monmouth Co., N. J., died at his home in Middletown recently, at the age of 69. Mr. HOPPING was a stanch Democrat and figured prominently in public affairs. He was a stockholder and director of the Second National Bank of Red Bank, and also large stockholder in the New York & Atlantic Highlands R. R. He leaves a widow and two sons.

PUBLICATIONS RECEIVED.

—*Eighth Annual Report of the State Board of Health of Indiana for the Fiscal Year Ending Oct.* 31, 1889. Cloth, 6⅛ x 9 ins. 326 pp.

—*Mayor's Message and City Clerk's Annual Report, Newburg, N. Y., for the year* 1889-90. Pamphlet, 84 pp. WM. C. MILLER, Superintendent water-works.

—*First Annual Report of the Board of Water Commissioners of the City of Dowagiac for the Year Ending April* 30, 1890. HENRY H. PORTER, President.

The report gives a general review of the construction of the works.

—*Official Reports of Various Duty Trials of the Gaskill Pumping Engines*, published by the Holly Manufacturing Co., Lockport, N. Y. 1890. Pp. 229.

A full illustrated description of this high-class pumping engine, with full detail of duty trials, with illustrations of pumps and diagrams.

—*Ninth Annual Report of the Water Commissioners of the City of Amsterdam, N. Y.* May 1, 1890. Pamphlet, 52 pp. A. H. DEGRAFF, Superintendent.

A description of the proposed new supply, and results of analyses of the water, are included in the report; also a classification of water lakes, with the number in each class.

—*Annual Report of the Board of Health of Missouri.* 1888. Cloth, 6 × 9¼ ins., 156 pp.

This belated volume contains in addition to the usual matter a brief report of the 14th annual meeting of the American Public Health Association, and a report made in 1888 by a committee of that association on the "Pollution of Water Supplies."

—*City Streets*, How to Build Them and Why. By Mr. L. W. Mathewson, Assistant Engineer of Board of Public Affairs, Cincinnati, O.

A reprint from the 11th annual report of the Ohio Society of Surveyors and Civil Engineers. It is illustrated and gives very considerable valuable detail relating to the construction of city streets. It can be obtained with the full report of the Columbus meeting of the Society from Secretary Julian Grigg, Columbus, O. Price 50 cents.

—*Twenty third Report of the Water Commissioners of the City of New Britain, Conn., for the Year ending Mar.* 31, 1890. Pamphlet, 20 pp. J. W. RINGROSE, Chairman. D. A. HARRIS, Superintendent.

The most noteworthy features of this report are the results of an analysis of water from the gate-house at Shuttle Meadow Lake, made by HERBERT E. SMITH; itimized cost of labor and material for new pipe laid during the year and for relaying old, and yearly receipts from 1858 to 1889, inclusive.

—*Pavements and Roads: Their Construction and Maintenance.* Reprinted from *The Engineering and Building Record.* Compiled by E. G. LOVE, Ph. D., *The Engineering and Building Record* Publisher, 1890. 8vo;

410 pp.—A most creditable and seasonable compilation of articles from various sources on the science of road-making. The contents include stone, wood, asphalt and brick pavements, county roads, curbs, sidewalks and tramways. It is decidedly the best collection of data on this important subject that has yet appeared in book form.

—*Three Essays on Trackwork* received in competition for prize offered by the American Society of Railroad Superintendents. 8vo. pamph., pp. 32, 41, 24; numerous cuts and tables.

This pamphlet contains three essays, which are by Messrs. ANDREW MORRISON, of the Lehigh Valley; H. W. REED, Master of Roadway, Savannah, Florida & Western, and EDWIN A. HILL, of the Cleveland, Cincinnati, Chicago & St. Louis Ry. They are all three very practical and valuable essays, and we advise everyone interested in trackwork to procure a copy. Certain parts of them we shall republish in this journal.

—*Eleventh Annual Report of the Ohio Society of Civil Engineers.* Columbus, O., meeting of Jan. 21, 22, 23, 1890. Price 50 cents. Julian Griggs, Secretary, Columbus, O.

Contents:—President's address; reports of committees; County Surveyors and the Law under which they Work, W. E. Peters, Athens, O.; Conditions and Needs of the Engineering Profession in Ohio, Samuel Bachtell, Columbus, O.; Operations of the Coast and Geodetic Survey, Prof. T. C. Mendenhall, Washington, D. C.; Water-Works for Towns and Villages, J. B. Strawn, Salem, O.; Rural Water Supply, its Conditions and Needs, J. Arnett, London, O.; Natural Gas, H. L. Weber, Bucyrus, O.; City Streets, How to build them and Why, L. W. Mathewson, Cincinnati, O.; The first free Turnpike in Tuscarawas Co., W. M. Ray; Maintenance of Way on Railroads, A. W. Jones, Columbus, O.

—*Reports on the Projected Works of the Tulare Irrigation District, Tulare County, Cal. by the Board of Directors and the Engineers.* Pamphlet, 47 pp. and map. J. W. MACKIE, President. P. J. FLYNN, Engineer.

A greater part of the pamphlet is taken up with Engineer FLYNN'S report. The works recommended consist of head works on the Kaweah river, a canal 9.15 miles long, including a 100-ft. flume and 700 and 1,100-ft. tunnels, a reservoir at the end of this canal with a large dam and outlet works, and finally a canal 25 miles long to convey water to and through the Tulare district. The district has an area of about 40,000 acres. The proposed reservoir would have an area of 657 acres and a capacity of 635,340,000 cu. ft., or about 4,750,000,000 galls. The dam would be of earth, without a heart-wall, 3,800 ft. long, and 56 ft. at the highest part.

In addition to further details and some matter of a general nature, relating to irrigation, the report contains various tables of rainfall and evaporation, and a short report made to the board in 1889 by JNO. S. URTON.

Annual Report of the City Civil Engineer of the city of Cleveland, for the year ending Dec. 31, 1889. Pamphlet, 88 pp. WALTER P. PRICE, Engineer.

There are in all 440 miles of streets and alleys, and of these but 66 miles, or one mile in seven, are paved. The work of paving was begun 35 years ago.

The report contains tables showing in some detail the improvements made during the year, and the cost of the same; also improvements under contract and in progress, and proposed improvements for 1890, with estimated cost.

The report closes with a table showing tensile tests, made in 1887-9, of 19 different cements, domestic and foreign. The total number of tests made in the three years was 982. The briquettes tested remained in water from one day to 12 months. For a one day test the greatest tensile strengths were shown by McLain's and Kuhlman & Myerstern's Portland cements, each being 225.5 lbs. The former is an English, the latter a German cement. The McLain cement made the best showing up to nine months, when the tests were stopped. The results in pounds were: One month, 623.5; three months, 653; four months, 620; six months, 616; nine months, 670. Only one cement was tested a year, the Louisville, with a result of 307 lbs.

—*The Paris Exposition.* By M. HENRI DE PARVILLE, Scientific Editor of the *Journal Officiel* and the *Journal des Debats.* 8vo., 710 pp., and 700 fine engravings. Paris: J. Rothschild, publisher, 13 Rue des Saints-Peres. (French text.) Price, $5.

This is not only a most artistic but a most useful illustrated history of the greatest of the Paris exhibitions, that of 1889. The preface is written by M. A. Alphaud, the Director General of Works of the Exposition. Commencing with an illustrated descriptions of previous great exhibitions in France and other countries, the one of 1889 is taken up at the very foundation, and these are described and shown with a minuteness that would do no discredit to a purely technical publication. After the erection, the cost and the various details preceding the opening are disposed of, the author describes and illustrates the various adjunct buildings and the surroundings of the main structures; gives statistics of the attendance; describes the various *fetes* of the exposition and then takes up the buildings and their exhibits in detail. The Eiffel tower is elaborately described, to the extent of 66 pages of text, and the description of the exhibit of public works contains much interesting engineering matter; the same is true of the exhibit of the city of Paris. It is an excellent work all the way through; but we would again warn our readers that the text is in French.

—*Gems and Precious Stones of North America.* A popular description of their occurrence, value, history, archeology and the collections in which they exist, also a chapter on pearls and on remarkable foreign gems owned in the United States. By George Frederick Kunz, gem expert with Messrs. Tiffany & Co., special agent of the United States Geological Survey, etc., New York, 1890. The Scientific Publishing Co., Publisher. Royal octavo, 336 pp., eight colored plates and many minor engravings. Price, $10.—This is a superb work that is justly attracting much attention, at home and abroad, from the value and interest of its contents, the well earned reputation of its author and from the typographical excellence of its text and illustrations. The manner of treatment is such that while very much technical information of value is given, regarding the location, the appearance and composition of the gems, this more useful material is most pleasingly set in other information that makes it read like a story. It is everything but the dull text-book that it might have been made had it fallen into the hands of a less sympathetic man than Mr. Kunz, or one less broadly informed on all that is properly included under the subject treated.

As the work is confined to the gems of North America, it may surprise some of its readers to find that diamonds are included in this area, and take up in their description the first chapter of 40 pages in this work. They occur, so far, in only two geographically remote and geologically dissimiliar regions. The first is a belt of country lying along the Eastern slope of the southern Alleghenies, from Virginia to Georgia; the other extends along the western base of the Sierra Nevada and Cascade mountains, in Northern California and Southern Oregon. In the first case the rocks in which they occur belong to the Archaen and Cambrian ages, and in the second case in the middle or later Mesozoic. The diamonds have been found in loose material associated with garnets, zircons, iron sand and particularly gold. The diamonds so far found have little more than local interest and moderate value, and Mr. Kunz does not think that diamond mining will ever rank as an important industry. The so-called Dewey diamond is the largest, found at Winchester, Va., in 1855, and after passing through various hands, was cut and valued at $6,000. Mr. Kunz says it was reduced from 23¾ to 11 11-16 carats by cutting, is off-color and imperfect, and is probably worth $400. Mr. Kunz continues with a detailed account of the finding of other diamonds, with many interesting circumstances connected with their discovery, concluding with an account of the celebrated Arizona "diamond swindle" of 1870.

Other chapters treat in an equally interesting manner of the sapphire, ruby, topaz, emerald, turquoise, garnet, beryl, etc. The wood agates and wood opals of Colorado and California furnish a topic of peculiar interest, with tree trunks 150 ft. and more in length transformed into chalcedony with its glorious colors; in one case a tree of agatized wood bridges a cañon 45 ft. in width. The pearl fisheries of California and Mexico also makes delightful reading. A New Jersey pearl found in 1857 was sold by Tiffany & Co. to the Empress Eugenie for $2,500 and to-day it is worth $10,000. The final chapter is on the gems of Mexico and Central America, with special reference to the jade, obsidian and rock crystal implements and ornaments of the old Indian races of this section. Mr. Kunz says that the word jade is evidently a corruption of *ijada*, and the mineral was brought from Peru and Mexico under the name of *piedra de ijada*, or "stone of the loins," in allusion to its supposed curative properties in diseases of the loins and kidneys.

SOCIETY PROCEEDINGS.

Engineers' Club of Cincinnati.—At the regular May meeting of the club Messrs. W. H. D. Totten, jr., Alfred Koechlin, G. P. Walker and John C. Lemon were elected members. Application for membership was received from A. A. Stuart. The members and some invited guests listened to a very interesting lecture by Col. Wm. E Merrill, U. S. Engrs., on "A Hasty Trip to the Last Paris Exposition." The lecture was illustrated by some 90 lantern views, and comprised a description of the Forth Bridge and the Eiffel Tower.

Engineers' Club of Philadelphia.—Regular meeting, June 7—On motion of Mr. Henry G. Morris the sense of the meeting was unanimously expressed in favor of officially indorsing the invitation, which had been extended to the Local Committee on Reception of the British Iron and Steel Association to make such use of the club's house as they might find convenient.

The Secretary presented, for Mr. Strickland L. Kneass, a description of a new condensing and refrigerating system. HOWARD MURPHY, Sec. and Treas.

American Society of Civil Engineers.—The following circular is issued: On account of the approach of the Convention and the desire of authors that their papers shall be presented at it, there will not be any paper presented in New York on Wednesday evening, June 18. The general arrangements for the Convention are as have been previously announced. The details of the programme are in charge of a local committee at Cresson, composed of members of the society and officers of the Pennsylvania R. R. residing in that vicinity. These details cannot yet be fully announced. It is expected, however, that the Convention will begin its sessions Thursday morning, June 26. The President's address will probably be made Thursday evening. Thursday, Friday, Saturday and Monday will be occupied partially by meetings and partially by short excursions by rail to points not far from Cresson, probably including Altoona, Johnstown (Cambria Iron Works), Bell's Gap. The banquet will occur, as now arranged, on Saturday evening. The Convention will probably close on Monday evening, or some time Tuesday, but doubtless many will stay at Cresson several days longer. The special train leaves Pennsylvania R. R. ferry, foot of Cortlandt or Desbrosses St., New York, Wednesday morning, June 25, at 10 o'clock.

Civil Engineers' Club of Cleveland.—Regular meeting, June 10, 1890. President Searles in the Chair, 28 members present.

Mr. Mordecai, Chairman of the Committee on Affiliation with the American Society of Civil Engineers, reported that he had communicated with Mr. Holloway, and requested him to represent the club at the coming conference of Engineering Societies in New York.

A letter was read from Mr. Warner, Chairman of the Committee on Rooms, stating that the contemplated arrangements had not yet been effected.

A letter was read from the Engineers' Club of St. Louis, accompanying a printed statement of the views of that club on affiliation with the American Society. Referred to the Committee on Affiliation.

A letter to the President from Dr. R. W. Raymond, Secretary of the American Institute of Mining Engineers, requesting him to represent the club at the autumn convention was read, and some announcements were made regarding the expected visit to this country of the Iron and Steel Institute of Great Britain.

On motion of Mr. C. G. Force, the club voted to hold a picnic at Rocky River in the latter part of July.

Dr. Herman Poole read a paper entitled "Ferroid—A New Artificial Stone," which was followed by discussion.

Prof. Chas. S. Howe read a paper on the Almucanter, a new instrument for Field Astronomy, greatly simplifying observations and calculations for time and latitude and resulting in a degree of accuracy scarcely excelled by the most elaborate instruments on solid foundations. This was illustrated by a large drawing prepared by Prof. Saunders, a member of the club. After an interesting discussion on this subject, the club adjourned.

F. J. BAKER, Cor. Sec'y.

Engineering Association of the Southwest.—Meeting of June 12, President John MacLeod presiding, 32 members and visitors present.

Mr. Landreth, from the Committee on the "Cause of Setting of Cement," postponed report due at this meeting. Chairman MacLeod, from the committee on "Affiliation with the American Society," reported that it had been impossible for any member of the committee to attend the meeting of the Committee of the American Society at New York on June 4, and asked the discharge of the committee, which was granted. The subject of joining the "Association of Engineering Societies" was discussed and correspondence with the officers of the Board of Managers of that organization was submitted. On motion the decision was referred to the Executive Committee of the Board, with power to act.

Mr. Jn. B. Atkinson, of Earlington, Ky., then presented his paper on "Coke Making in the Western Kentucky Coal Field." The paper dealt very extensively with a series of trials and experiments carried on at Earlington, Ky., for the purpose of solving for that district the question of desulphurization of coke, which is here made from slack coal only, carrying a higher percentage of sulphur than the coarser grades of coal. The author gave accounts of his travels and investigations seeking light on this subject of so great importance to the Western Kentucky coal fields, but found the condition and character of the coal and the manner of the occurrence of the sulphur in the coal so different from that found elsewhere that no parallel whatever could be drawn from outside experience. This was verified by repeating at Earlington in succession and without avail the methods which were elsewhere successful. Mr. Atkinson's results to date are only partially successful, but they are still being prosecuted, and should they be rewarded, as the author expects, with ultimate success, the result will be of the greatest commercial importance to the Western Kentucky Coal Belt, whose product is at present unsuited to iron making.

Owing to the unavoidable absence of Mr. A. V. Cude of Atlanta, Ga., his paper on the "Foundations of the Georgia Pacific Ry. Bridge Over the Yazoo River, Miss." was deferred. OLIN H. LANDRETH, Secretary.

New England Water Works Association.—The ninth annual convention of this association was opened in the City Hall Building at Portland, Me., at 2:30 P.M., June 11. President Brackett in the chair, with Secretary Coggeshall and about 100 members and visitors in attendance. The address of welcome by the Mayor was

postponed until evening. Regular routine business was attended to, and the president read his annual address.

We have assembled here to-day in this beautiful city to hold our ninth annual convention. The few moments of your time which I shall occupy, I propose to devote to a brief statement of the work of the association.

From a membership of 43 at the second annual convention at Worcester in 1883, our numbers have increased steadily year by year, until we now have a total membership of 335, divided into three classes, 257 active, 5 honorary, and 73 assistant members. About 200 of the active members are residents of New England, representing the water-works' departments of 109 cities and towns.

It seems to me that the growth of the association and the good work which it has accomplished during the past eight years must have exceeded the most sanguine expectations of the original projectors.

We have to-day a membership as large or larger than that of the American association, and during the past year our gain in membership has been more than double that of our sister organization.

Although the greater portion of our members are residents of New England, we include in our ranks representatives of water departments in 25 different States and Territories outside of New England.

The meetings of the past year have been well attended, and the papers presented at those meetings, with the informal discussion of topics relating to different branches of the question of water supply have been most instructive.

The three days' excursion to the Crawford house and North Conway in September was to those who participated an occasion of rare enjoyment and one which will not soon be forgotten.

Most thoroughly do I believe in the encouragement of the social features of our meetings by these excursions and by the informal gathering and dinner previous to our monthly winter meetings. In no other way can so good opportunities be afforded for informal discussion and for the interchange of ideas on all subjects in which we have a common interest.

At our first winter meeting in December we listened to Mr. Freeman's paper on Fire Streams. The description of these experiments and the results deduced therefrom in the practical tables constitute a most valuable contribution to the subject of hydraulics.

Mr Forbes' paper on Algæ, with the accompanying discussion, is a valuable addition to our knowledge of a subject concerning which too little is known, and one which is of vital importance to many cities and towns, not only of New England but throughout the world.

The short papers presented at the meetings of January and March covered a wide range of subjects pertaining to our daily work and gave us all facts of value or question for study.

Such has been the record of the year past. What shall it be during the year to come? Let me briefly outline a few of the questions to the study of which we may well devote our energies.

The question of the quality of our water supplies, and how the quality may be preserved or improved, is one which presents to view, in its different phases, numerous subjects, among which I may mention Algæ and other growths in ponds and in ground-water supplies by filtration, æration, etc.

A very careful study of the water supplies of Massachusetts is being made under the direction of the State board of health, and we can very materially aid this work by personal observation and record of the changes which occur in the quality of the water supplies under our charge.

The comparative merits of the cast iron and wrought iron and cement pipes have been in years past a fruitful topic of discussion, which has now, I think, been practically settled in the minds of the majority of our members, but the questions as to the minimum thickness of iron allowable in pipes, the best form and dimensions of pipe sockets, and of special castings, are still unsettled and are well worthy of our careful study.

The preservation of the purity of our water supplies is a subject which is assuming more and more importance as our country becomes thickly settled, and as a society we should use our influence to obtain such legislation as will prevent the pollution of streams used as sources of water supply.

The prevention of waste has been discussed at a number of our meetings, but the subject has not been by any means exhausted. In this question I have for a number of years taken a vital interest, as I believe that with many of our municipalities, perhaps not with Portland, the day is fast approaching, if it is not already arrived, when they cannot afford to waste from 30 to 60% of the water drawn from these sources of supply. In the minds of some of our associate members there is no doubt as to the proper means of preventing this waste, and the best meter is supposed to be on exhibition in the adjoining room.

The careful consideration of these and all other questions pertaining to our daily work is the object for which our association exists. In the eight years which have passed we have grown in numbers and increased our knowledge of the questions with which we are dealing from day to day, but increased knowledge and experience widens our opportunities for future advancement. Although our membership includes representatives of most of the larger works of New England, only about one third of the total number are represented in the association and we have as many members in California as in Vermont.

In closing I desire to thank you for the honor which you have conferred in placing me in the position which it has been my pleasure to occupy during the past year, for your courtesy and forbearance and for your hearty co-operation. Whatever of success has attended our meetings has been due to your earnest efforts and to the faithful and painstaking work of our secretary and junior editor.

It has given me the greatest pleasure, and I think that my feelings are shared by every member who has had the opportunity, to testify in a slight manner my appreciation of the services which have been rendered to the association by our faithful secretary. To his unflagging interest and careful attention is due a great measure of the success of the association not only in the year past, but during all the years since the association was formed. He has done what he could. Let every member resolve to follow his example, and the work so well begun will continue and expand until not only ourselves, but every city and town in New England will recognize the good work of the New England Water-Works Association.

The secretary's report showed a net gain for the year in membership of 58, with a total of 335, and the treasurer's report showed a balance in hand of $1,129.30.

Chas. W. Morse, Esq., of Massachusetts, read a paper on the question, "Is public or private ownership and management better for the patrons of water-works?" The paper strongly advocated private ownership.

There could be but one conclusion to a discussion on such a paper in such a convention. Of 70 members registered at the headquarters of the Association 53 were from Massachusetts. Referring to page 12 of the Introduction to the Manual of American Water-Works for 1888, we learn that 87 per cent. of the water-works of Massachusetts are owned by the cities or towns supplied by them. In Maine, however, only 4 out of 42 are city ownership, and there is no doubt that it has been this private ownership which has helped the small cities of Maine to the luxury and benefits of a liberal water supply. But the arguments of the convention were too much against private ownership, and only Mr. Holden, of Nashua, came forward in favor of Mr. Morse's plea.

The subject of "Water Hammer" was discussed briefly, and after a few words also on the measuring of water for use of railroads, the meeting adjourned.

The evening session was held around the banqueting table, spread by the hospitality of the Portland Water Company, the President of which, Mr. D. W. Clark, presided. The address of welcome by the Mayor, deferred from the opening session, followed the opening speech by President Clark. Other speeches followed by prominent Portland men who, one and all, certified to the unlimited quantity and absolute purity of Lake Sebago water, and also to the thoroughly beneficent administration of the Water Company, the truly lovable disposition of which is beyond dispute.

At the morning session on Thursday, the following officers were elected to serve for the ensuing year: *President*, Albert P. Noyes, West Newton; *Vice-Presidents*, George P. Wescott, Portland; Charles K. Walker, Manchester; F. H. Crandall, Burlington; P. Kieran, Fall River; W. B. Sherman, Providence; W. H. Richards, New London; *Secretary*, R. C. P. Coggeshall, New Bedford; *Treasurer*, Hiram Nevons, Cambridge; *Senior Editor*, F. H. Parker, Birmingham; *Junior Editor*, Albert S. Glover, West Newton; *Executive Committee*, Frank E. Hall, Quincy; Dexter Brackett, Boston; Charles W. Morse, Haverhill; *Finance Committee*, H. F. Whitrier Lawrence; George E. Winslow, Waltham; F. A. Andrews, Nashua.

Prof. Wm. T. Sedgwick, of the Massachusetts Institute of Technology, addressed the meeting on the subject of "River Water for Drinking Purposes," the matter of his remarks being an abstract of a German magazine article on that subject and devoted mainly to proving from experiments the value of filtration of river, or surface' waters, and of its application to large volumes of water. The information given by the speaker was very interesting and valuable, and he stated, in reply to a question, that the entire article would be translated and published by Prof. Drown in the near future. The subject of filtration and aeration was further discussed by Mr. Fitzgerald and Mr. Bayles.

A paper by Mr. P. F. Crilly, supt. of water works at Woburn, Mass., on "Why I favor the Use of Cement Pipe" was read. After all that has been published in this journal and in numerous water works reports on the eccentricities of cement pipe, it was with genuine curiosity and admiration that Mr. Crilly was looked at and listened to. At the conclusion of the paper a somewhat ominous quiet prevailed for a minute or two, when Mr. Walker, of Manchester, who, it is understood, has had some experience with cement pipe, was called on to tell what he knew of the subject. Mr. Walker prefaced his remarks by saying that he had come from Manchester on purpose to hear this paper and look at the man who had the courage to read it. Mr. Walker's remarks about cement pipes were forcible and direct, and he left no doubt in the minds of his hearers as to his opinion. He had tried cement pipe and he didn't want any more of it at any price. Other members told their experience, and there was not even one who could encourage Mr. Crilly in his peculiarity. Apparently he was so overpowered at the unanimity of condemnation of his favorite pipe that he concluded silence was wisdom as he had no further argument to advance to sustain his position on the matter.

The afternoon session was opened by an interesting informal talk about the New Croton Aqueduct by Chief Engineer Fteley, who illustrated his remarks by numerous and interesting stereoptican views of the New Croton Aqueduct tunnel in different stages of construction, machinery used in construction, and of the several dams, etc. The great magnitude of the work was dwelt upon by Mr. Fteley as being the most interesting feature.

Jno. A. Gould, Jr., of Boston, read an interesting paper on "Recording Gauges," and was followed by Mr. G. A. Rouiller, of Flushing, N. Y., in a paper on "Water Meters: The Advisability of Their Use," which was discussed by several members."

The topical subject, "What is the minimum size of mains to be used for domestic and hydrant use," was discussed by Messrs. Allis, Fuller, and others. Mr. Allis thought the 4-in. mains would do for domestic use, but should not be used for water supply for fire engines. Mr. Hawes had never seen pipes too large, but a great many were too small. Mr. Walker favored the 12-in., crossed by 8-in. and 6-in., and the 4-in. should not be used except in sparsely populated sections.

The president explained at some length the workings of a scraper which had been successfully used by the Boston Water Board in clearing out 6-in. pipes.

Other topics discussed were "The depth of lead necessary in pipe-joints," and the "Standard size of hose hydrants." Votes of thanks were extended to the Portland Water Co. for its many and liberal courtesies to the convention; to the city of Toronto, Can., for its courteous invitation to hold the next meeting in that city; to the Mayor of Portland; to Mr. Fteley and to President Brackett. On account of rain the excursion to Lake Sebago and the drive about Portland were omitted. The convention closed on Thursday, the next convention to be held in Hartford, Ct., in 1891.

The following were elected at Portland:

Active Members: James Birnie, Biddeford, Me.; C. M. Brainard, Skowhegan, Me.; D. W. Clark, Portland, Me.; A. F. Crockett, Rockland, Me.; Francis W. Dean, Boston, Mass.; J. C. Bayles, East Orange, N. J.; Chas. R. Dyer and E. R. Dyer, Portland, Me.; W. J. Goldthwaite, Marblehead, Mass.; Arthur W. Hunking, Lowell, Mass.; Fred. W. Gow, Medford, Mass.; Wm. Jackson, Boston, Mass.; W. McNally, Marblehead, Mass.; J. T. Murphy, Marblehead, Mass.; Wm. Hamilton, Toronto, Ont.; C. N. Pratt, Utica, N. Y.; E. M. Treman, Ithaca, N. Y.; J. Nelson Tubbs, Rochester, N. Y.; B. D. McConnell, Montreal, Can.

Associate Members: King & Godard, Boston, Mass.; Perrin, Seamans & Co., Boston, Mass.; Rensselaer Mfg. Co. Troy, N. Y.; Standard Thermometer Co., Peabody, Mass., Taunton Locomotive Works, Taunton, Mass.; E. B. & J. N. Winslow, Portland, Me.; Smith & Anthony Stove Co., Boston, Mass.

The following is a list of members of all classes and visitors registered at headquarters during the Convention:

Frank A. Andrews, Nashua, N. H.; Solon M. Allis, Malden, Mass.; George E. Batchelder, Worcester, Mass.; Charles H. Baldwin, Box 2,410, Boston, Mass.; Lewis M. Bancroft, Reading, Mass.; Albert P. Barrett, Woburn, Mass.; Chas. A. Barton, Waltham, Mass.; Dexter Brackett, and Mrs. Brackett, 221 Federal St., Boston, Mass.; M. F. Brennan, Lowell, Mass.; E. W. Cate, 113 Devonshire St., Boston, Mass.; George F. Chace, Taunton, Mass.; Jonas M. Clark, Northampton, Mass.; R. C. P. Coggeshall, and Mrs. Coggeshall, New Bedford, Mass.; F. H. Crandall, Burlington, Vt.; P. F Crilly, Woburn, Mass.; A. B. Daggett, and Mrs. A. B. Daggett, Boston; Nathaniel Dennett, Somerville, Mass.; W. A. Dickenson, Lowell, Mass.; Chas R. Dyer-Portland, Me.; Eben R. Dyer, Portland, Me., Horace L. Eaton, Somerville, Mass.; Desmond FitzGerald, Brookline, Mass.; Frank L. Fuller, 12 Pearl street, Boston, Mass.; Albert S. Glover and Mrs. Glover, West Newton, Mass.; Fred. B. Gleason, Marlboro, Mass.; J. A. Gould, Jr., City Hall, Boston, Mass.; Robert M. Gow, Medford, Mass.; E. H. Gowing, Reading, Mass.; Samuel M Gray, Providence, R. I.; Wm. Hamilton, Toronto, Ont.; William M. Hawes, Fall River, Mass.; Rudolph Hering, 277 Pearl street, New York City; Horace G. Holden, Nashua, N. H.; Horatio N. Hyde, Jr., Newtonville, Mass.; Patrick Kieran, Fall River Mass.; Wilbur F. Learned, City Hall, Boston, Mass.; Joseph A. Lockwood, Yonkers, N. Y.; H. H. Lowe, Clinton, Mass.; James L. Lusk, Capt. Corps of Engineers, U. S. A., Washington, D. C.; A. E. Martin, South Framingham, Mass.; Willis E. McAllister, Calais, Me.; J. A. Mitsch, Boston; Robert E. S. Mortunic, Marlboro, Mass.; Charles W. Morse, Haverhill, Mass.; Hiram Nevons and Mrs. E. B. Nevons, Cambridge, Mass.; Weaver Osborne, Fall River, Mass; F. H. Parker and Mrs. F. H. Parker, Burlington; Vt.; A. G. Pease, Spencer, Mass.; John F. Philbin, Clinton, Mass.; Edward H. Phipps, New Haven, Conn.; George J. Ries, Weymouth Center, Mass.; Walter H. Richards, New London, Conn.; J. W. Ringrose, New Britain, Conn.; G. A. Roulifer, Flushing, N. Y.; W. J. Ranton, Syracuse, N. Y.; A. H. Salisbury, Lawrence, Mass.; Arthur F. Salmon, Lowell, Mass.; Professor William T. Sedgwick, Boston, Mass.; George A. Stacy, Marlborough, Mass.; Frederick P. Stearns, Chief Engineer, State Board of Health, 13 Beacon St., Boston, Mass.; B. F. Steben, Brockville, Ontario, Canada; Eugene S. Sullivan, Charlestown, Boston, Mass.; Fred A. Volk, Ware, Mass.; Levi C. Wadleigh, Haverhill Mass.; George P. Westcott, Portland, Me.; W. H. Whitcomb, Norway, Me.; Frank W. Whitcock, Waterbury, Conn.; John C. Whitney, West Newton, Mass.; Frederick W. Wilder, Woodstock, Vt.; George E. Winslow, Waltham, Mass; E. T. Wiswall, West Newton, Mass.; Timothy Woodruff, Bridgeton, N. J.; Millard F. Wright, Lowell, Mass. George H. Frost and Mrs. Geo. H. Frost, ENGINEERING NEWS, Tribune Building, New York City; Henry C. Meyer, 277 Pearl St., New York City; F. W. Shepperd, 14 Cortlandt St., New York City.

Associate Members and Exhibitors—American Frost Meter Co., Boston, Mass.; H. R. Barker Mfg. Co., Pipe and Fittings, Lowell, Mass.; A. H. Austin, King & Goddard, Chicago; Harold L. Bond, Boston, Mass.; Chapman Valve Mfg. Co., Edward L. Ross and wife, Indian Orchard, Mass.; W. N. Goddard, King & Goddard, Boston; W. M. Gearing, Fairbanks, Brown & Co., N. Y.; Hersey Meter Co., Jas. A. Tilden & H. De Winter, So. Boston, Mass.; Hydrant and Iron Works, Holyoke, Mass.; Octavius Jones, Rensselaer Mfg. Co., Troy, N. Y.; National Meter Co., 252 Broadway, New York City; Peet Valve Co., 163 Albany St., Boston, Mass.; Perrin, Seaman & Co., Boston, Mass.; William J Ranton Superintendent Porter Mfg. Co., Limited, 1,204 Spring St., Syracuse, N. Y; Rensselaer Mfg. Co., Troy, N. Y.; Smith & Anthony, Boston; George Ross, Valves, Troy, N. Y.; Standard Thermometer Co., Peabody, Mass.; Taunton Locomotive Works, Taunton, Mass.; Benjamin S. Terry (A. W. Harris Oil Co.), 85 Hope St., Providence, R. I.; Union Water Meter Co., 31 Hermon St., Worcester, Mass.; Walworth Mfg. Co., Pipe and Fittings, 16 Oliver St., Boston, Mass.; W. H. Ward (W. H. Ward & Co.), Plumbers' Supplies, 140 Oliver St., Boston, Mass.; Water Waste Prevention Co., Thompson Water Meter, 12 Temple Court, N. Y.; E. B. Williams, Fairbanks, Brown & Co., Steam, Gas and Water Valves, 33 Milk St., Boston, Mass; Wm. Wolfendale, Agent Plumbers' Supplies, 76 Second St., Fall River, Mass.; R. D. Wood & Co., Jesse Garrett, Cast Iron Pipe, 400 Chestnut St., Philadelphia, Pa.; Whittier Machine Co., "Adamanta Covered Pipe," Gates and Hydrants, Granite, cor. First St., South Boston, Mass.; E. B. Winslow, Portland, Me.; J. N. Winslow, Portland, Me.

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Advertising rates, 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if those who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, July 7. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting, July 7. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Club, Cleveland, O.—Next meeting, July 7. Secy., C. O. Palmer, 22 Cedar Ave.

American Society of Civil Engineers, New York.—Annual convention, at Cresson, Pa., June 26. Secy., John Bogart, 127 E. 23d St.

Western Society of Engineers, Chicago, Ill.—Next meeting, July 2. Secy., J. W. Weston, 230 La Salle St.

Association of Civil Engineers, Dallas, Tex.—Next meeting, July 4. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Philadelphia, Pa.—Next meeting, July 5. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, July 9. Secy., J. C. Herring, Wichita.

New York Railway Club.—Next meeting, July 17. Rooms, 113 Liberty St.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, July 10. Secy., Olin H. Landreth, Vanderbilt University.

Engineers' Society of Western Pennsylvania.—Next meeting, July 15. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, July 16. Secy., S. E. Tinkham, City Hall.

THE New York Rapid Transit Commission, unless all accounts are wrong, has practically concluded to report in favor of what is called the Fourth Avenue route, for sunken tracks or tunnels; the route running from the City Hall nearly due north, parallel with Broadway, through Elm St. (which will probably be widened, raised in grade, straightened and otherwise improved); thence through private property to Lafayette Place, and thence up Fourth Ave. to the Grand Central Station at Forty-second St., there making a connection with the Harlem, New York Central and New York & New Haven roads, so that suburban trains over each of them can be run to the City Hall direct, as they no doubt soon will be. And these three roads alone will furnish a pretty fair traffic for a four-track road. Whether the recommendations will cover an extension of the road up Madison or Lexington Aves., is still in doubt; but whatever the recommendations, it is not likely that this upper part will be built at once.

The recommendations seem wise in this: that this route affords the most evident and simple way for immediate partial relief. More than this it does not. The new tracks will hardly be built before they will be overcrowded with traffic originating north of the Harlem River, leaving the present traffic of the existing lines to stand about as it is, or a little worse; and the rapid transit problem will still be as serious as ever. But the Fourth Ave. extension is so evidently the proper thing to do at once that confining the first recommendations to this route seems wise nevertheless. The point is not unnaturally raised that the tracks above Forty-second St. are pretty well crowded as it is; but by suitable arrangement of terminals and tracks this difficulty can probably be overcome.

THE average haul question appears to be one of those, which will never down. A correspondent writes us:]

I want a full discussion of this matter of average haul over 500 ft. I am not fully satisfied yet. You, gentlemen, have an opportunity to know all about these matters, and are familiar with all new publications and discussions of this matter; and if you can send me anything more on the same subject, please do so, and I will remit to you promptly. We pay 1½ cts. per cu. yd. additional for haul over 500 ft. Where does this 500 ft. begin? Some say it begins at the grade point of the cut, and is 500 ft. on the side of fill. Others say it begins half in cut, half in fill. What is the custom?

Practice on this point is well settled. Each individual yard which can be taken from the cut and placed in its proper position in the fill without hauling it over 500 ft. (if that is the limit fixed), comes within the limit; all others are entitled to overhaul allowance; so that the average haul on the material which comes within the limit of 500 ft. is not over 250 ft., more or less. The "free haul" section is consequently just 500 ft. long, with the grade point somewhere near the middle of it. As for sending our correspondent all that has been written on the subject, we must decline the contract; first, because the total cost would be apt to "break" him, and we should lose our money; secondly, because we look on the numerous fine-spun theories and methods which have been elaborated on this subject as mere waste of time. If our correspondent has his volumes for cut and fill computed in successive solids of 20 to 100 ft., as he should have, it is but little work to run over his profile, and where there is any chance for overhaul allowance to portion off his successive cut solids, starting from the grade point, to their proper place in the fill, allowing 10 per cent. for shrinkage; and thus to determine just how much of each solid must be hauled over 500 ft., over 600 ft., etc., as his specifications require. The modern tendency is to do away with all overhaul allowance, letting the contractor bid on the profile as it is, and either waste and borrow or haul as he pleases. In any case it is a poor place for hair-splitting.

PERHAPS the most interesting single exhibit at the late Master Car Builders' Convention, and certainly the one which attracted most attention, was a glass model of a combined direct and indirect system recently introduced by the Consolidated Car Heating Co., of Albany, N. Y., by which the entire process of circulation under all conditions could be readily observed. It was well calculated to remove doubts as to the practical availability of a combined system, and as such deserved the careful attention it received. It is obvious from the existing diversity of practice, as recorded in our issue of June 7, as well as theoretically, that both the direct steam and indirect (or circulating hot water) systems of heating have something to recommend them.

The direct system will heat up a car considerably quicker than any indirect system can, and will also give out more heat, so as to heat a car comfortably in colder weather. The indirect system has the immense advantage of admitting of a nicer graduation of the heat to the requirements of the weather, which is all but impossible with the direct system, except by the aid of a thermostat, for reasons explained in our issue of June 7. But the indirect system has the disadvantage of greater complexity, and danger of the circulating water or brine freezing in the pipes in extremely cold weather. Any system which, while it is desired, is a direct system, but is at once converted into an indirect by the simple expedient of shutting off the escape of the water of condensation, and so allowing it to fill the pipes, has obvious and great advantages over the simple form of either system, if it works well in practice; and that it will do so, so far as a working model could demonstrate such a thing, was demonstrated by the glass model referred to. When the trap was closed the condensed water accumulated quite rapidly, and began to circulate somewhat almost from the first, the supposed difficulty of avoiding pockets of air in the pipes, so as to choke circulation, being an obviously imaginary one. We look forward with some confidence to seeing combined systems of this type, doubtless with modifications of detail, steadily grow in favor.

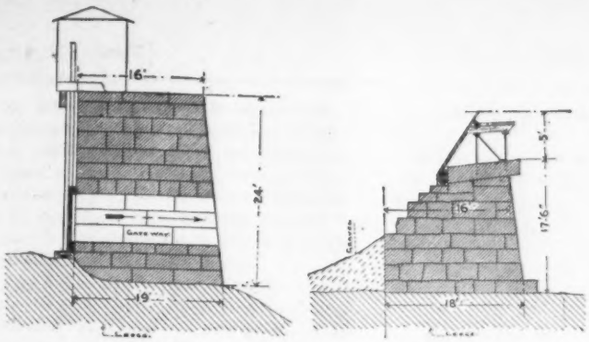
A NOTICE of somewhat more than usual interest for contractors having any leaning toward foreign work appears in an advertisement in another column, relating to the sewerage of Pará, Brazil, to which it seems proper that we should call some especial attention.

Pará is a very considerable city; the second or third largest in Brazil. Its population has been growing very fast, and is now something like 50,000 or 60,000, we understand, having increased from 24,000 in 1820. It has a very active trade, and for a tropical city a wonderfully pleasant and healthy climate, and with an extremely even temperature throughout the year; the nights are almost always cool, and the day temperature commonly reaches 90° or 91°, rarely rising above this, however, while shortly after noon a shower generally sets in, the year round, quickly cooling the air, and by sunset the ground is dry again. It is a very important trade center, as almost every one knows, and is as favorable a spot for any one to undertake a foreign contract, perhaps, as can be found in the tropics. Americans are reaching out more and more toward these foreign enterprises, and to the advantage, we believe, of all concerned. A notably recent instance is the American enterprise in the Island of Jamaica.

We shall be happy to give to any one interested information which is in our possession in regard to this work, and now simply state for the benefit of all interested that the terms of payment and other conditions fixed for the proposals asked seem to be equitable, not to say liberal, and reasonably secured.

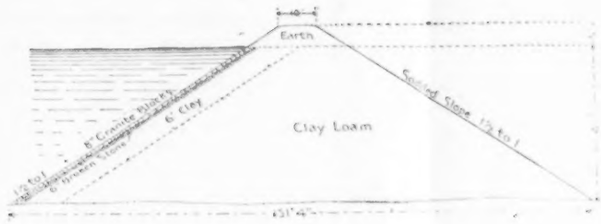
The Mechanical Filtration of Water.

In the earlier history of the water supply of towns in this country the chief problems were those of pumps, reservoirs and distribution. Water, pure and undefiled, was plentiful and near at hand, in what was then believed to be unbounded volume, far in excess of all possible "present and future" demands. Our rivers and smaller streams were as yet uncontaminated by sewage, as we now know it; great factories had hardly yet commenced to pour their filth into them, their banks

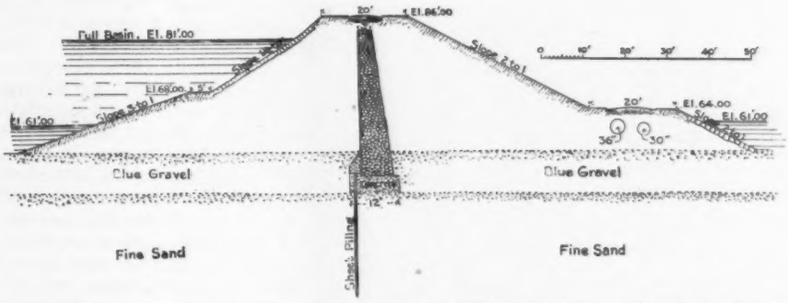


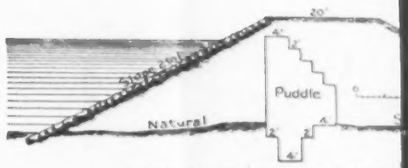
Section through Gateway. Section through Rollway.

DAM AT LAKE SEBAGO, PORTLAND, ME.

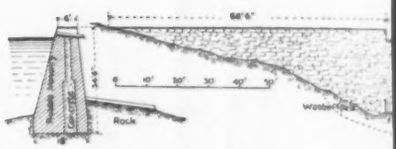


MUNJOY HILL RESERVOIR EMBANKMENT PORTLAND, ME.

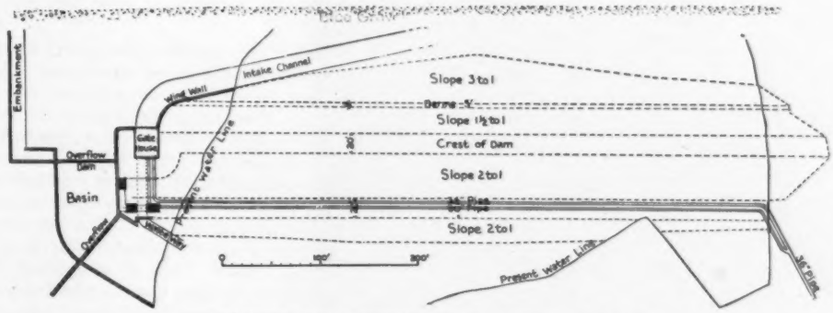




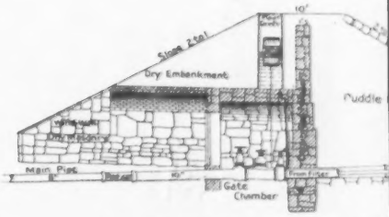
DAM ON ACUSHNET RIVER, NEW B



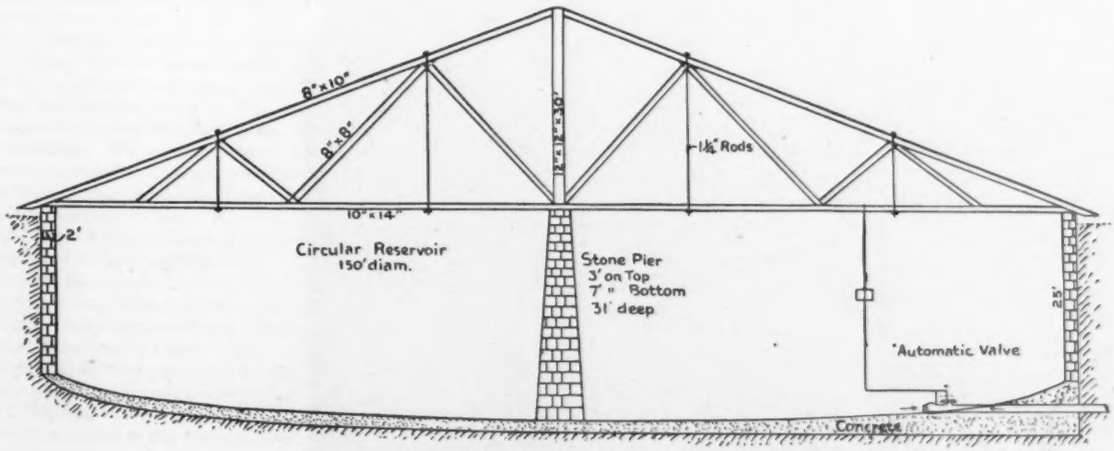
COVE RIVER DAM, WEST HAVEN, CONN. —E



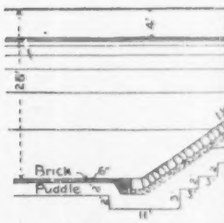
STONY BROOK DAM, CAMBRIDGE, MASS. —SECTION AND PLAN.



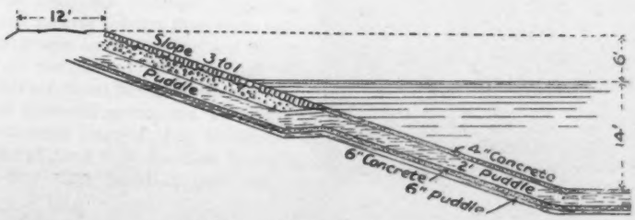
DAM FOR DISTRIBUTING RESERVOIR, W



COVERED RESERVOIR, PIERRE, SO. DAK —CROSS SECTION.

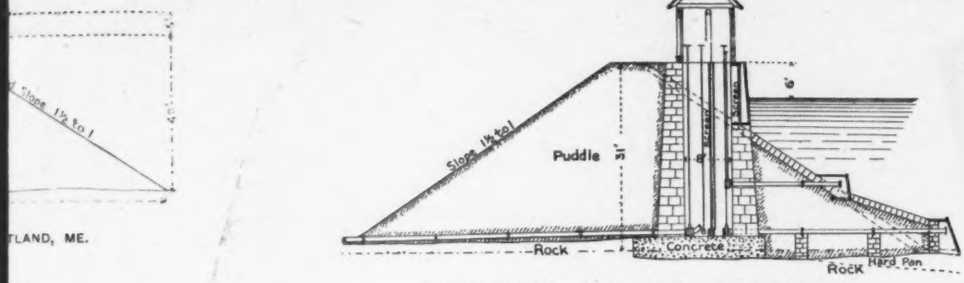


COMPTON HILL STORAGE



RESERVOIR EMBANKMENT, LONDON, ONT.

McTAVISH ST. RESERVOIR EMBANKMENT, MONTREAL, P. Q.



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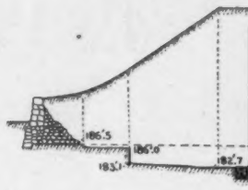
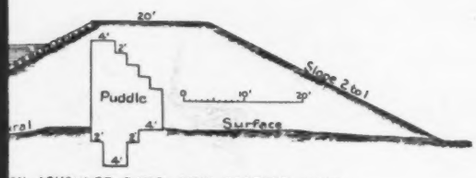
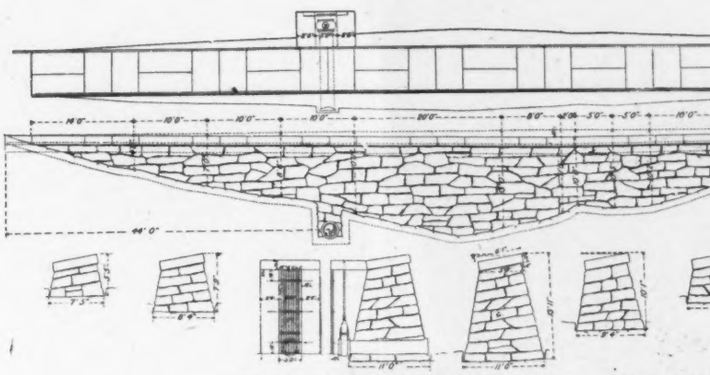
DUDLEY BROOK DAM AND GATE-HOUSE, WINDSOR, VT.



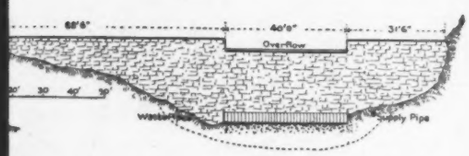
SALISBURY



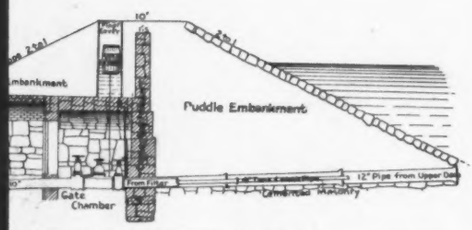
ON ACUSHNET RIVER, NEW BEDFORD, MASS.



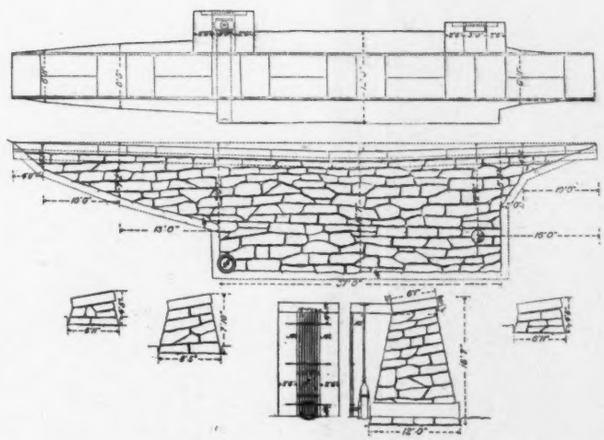
DAM ON MIDDLE BROOK, BOUND BROOK, N. J.—PLAN, ELEVA



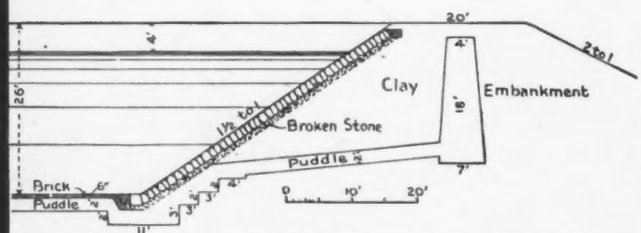
M. WEST HAVEN, CONN.—ELEVATION AND SECTION.



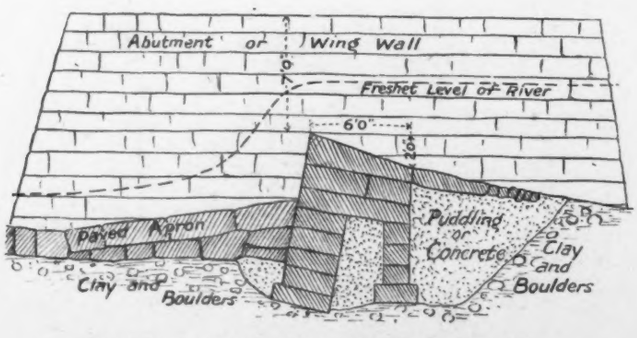
DISTRIBUTING RESERVOIR, WATERVILLE, N. Y.



DAM ON MIDDLE BROOK, BOUND BROOK, N. J.
PLAN, ELEVATION AND SECTIONS.



COMPTON HILL STORAGE RESERVOIR EMBANKMENT, ST. LOUIS, MO.



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DAM ON ST. CHARLES RIVER AT LORETTE, QUEBEC, P. Q.

DAMS AND RESERVO

FOR WATER-WORKS IN THE U

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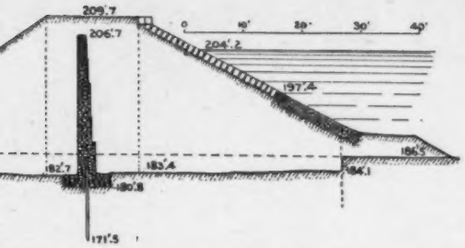
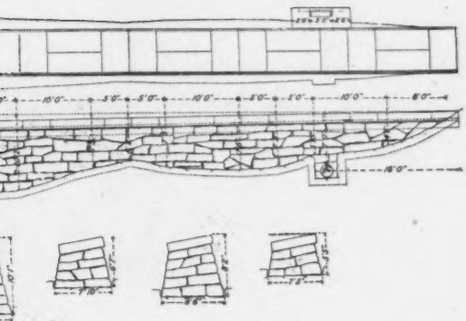


ALISBURY BROOK DAM, BROCKTON, MASS.



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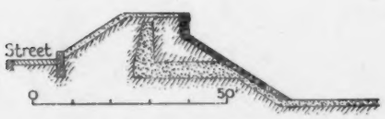
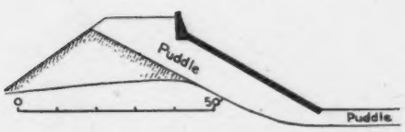
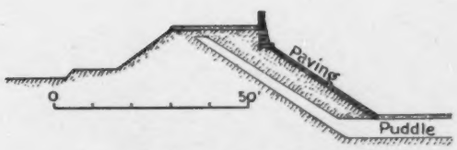


High Service Reservoir.



Low Service Reservoir.



Receiving Reservoir.

RESERVOIR EMBANKMENTS, JERSEY CITY, N. J.

ERVOIR EMBANKMENTS

THE UNITED STATES AND CANADA.

LEVATIONS AND SECTIONS

T WITH OFFICIAL REPORTS FOR PUBLICATION IN

OF AMERICAN WATER-WORKS.

were too thinly settled to make agriculture objectionable, and the wastes of collieries, of oil distribution, and the thousand and one other sources of pollution, to-day so common, were practically unknown scarcely a generation ago. Good water flowed by our doors then, and the engineer had but to lead it into a pump-well, lift it to a reservoir and distribute it to consumers.

All this has changed, most radically. In 1840 there were but 49 public supplies of water in the whole United States, and but two in all Canada. To-day, there are over 1,900 water-works in the United States, and over 100 in Canada, and the total capital invested in them exceeds $500,000,000, an aggregate of value in public works of a civil nature only second to our railway interests. At the date first mentioned our total population was only 17,069,453; to-day it may somewhat exceed 65,000,000.

As a consequence of this phenomenal growth, the rapid spread of population, the enormous increase in manufactures and industries of all kinds, and the almost universal demand for the luxuries as well as the necessaries of life, resulting from a higher civilization and a more liberal distribution of wealth, the multiplication of water-works has about kept pace with our advance in other directions. But some vigorous "spurting" was necessary in several years to "catch up" in the race, as notably in 1884, when 106 separate works were built, and in 1888, when the number of new works was 259.

While the ever growing demand for efficient and economical machinery and appliances connected with water pumping and distribution has been well met by manufacturers, and our engineers have introduced many novelties and constantly better work into the larger supplies, the chief problem that now engages the attention of communities and engineers is not so much the distribution of water as it is one of securing any pure supply at all, without seeking it at a distance that often is prohibitory in cost. Water is just as abundant and near at hand as it was 50 years ago; but the very conveniences that a water supply make possible, the improved and extended sewerage and the paving and draining of our streets into the surrounding water courses, have often rendered the old supply absolutely unfit for domestic, and even for manufacturing, use.

In this ever extending search for potable water, especially in cases where the town cannot afford the cost of long aqueducts and heavy machinery, many streams are rejected owing to the presence of earthy and other impurities that could be removed by filtration. For some reason, which we cannot explain, hydraulic engineers seem to look askance at the artificial purification of water, and from the standpoint of 20 years ago we cannot blame them. The Chelsea system of sand filter-beds, though used extensively abroad, is costly in its first installment, expensive to keep in operation and under certain conditions is of more than doubtful efficiency in removing the class of organic impurities most dangerous to health. Late experiments in Berlin show that under any forcing system bacteria pass through sand filters almost as readily as if the sand was not there, and only the earthy matter, apparent to the eye but least dangerous to the consumer, is removed. Any system of this kind is worse than dangerous, for it may deceive all connected with it, and deal out disease and death in the guise of a clear, sparkling fluid.

But while American hydraulic engineers have had little to do with foreign filter beds, citizens of the United States have been the first to introduce methods of mechanical filtration and chemical purification combined in machines that have stood the test of extended service and have long passed the experimental stage of their existence. As at first produced they were doubtless faulty in their working and often failed in part from lack of durability or convenience in service. But careful study of conditions and demands, and the mechanical skill of American engineers have gradually eliminated these defects, until to-day machines are produced combining all the desirable qualities of efficiency, durability, economy and convenience in operation; machines that can be applied to any service, from a household filter to the demands of large factories or to the supply of cities and towns.

Passing water through sand alone may clean it, but this operation does not purify it of the matter held in suspension and invisible to the eye. Other processes are necessary, and among the most efficient may be mentioned the use of alum, oxide of iron, lime, powdered coke, artificial aëration, etc. The action of coagulants in massing impurities has long been understood and applied in the refining of sugar and in other industries, but objection has been made to the application of alum for this purpose in the purification of water to be used for domestic purposes, in the belief that some of this agent might remain in the water. This objection is absurd to any one who will take the trouble to study the action of this coagulant. In the first place the usual quantity is in the proportion of 1 drop in 100,000 of the total volume, and if the alum did remain there it could do very little harm. But the real office of this minute injection of alum water is to gather together the impurities for which it has an affinity and bring them into appreciable masses that can then be treated by the other processes of the filter. When these impurities are removed the alum goes with them and the water is left free from all harmful ingredients.

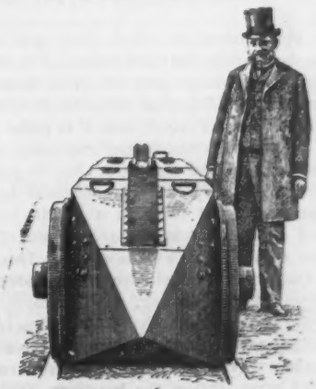
One of the serious objections to a sand filter is the deadening of the water, so to speak, even though the inorganic and mineral impurities are removed. In this respect the mechanical filtering process has great advantages, and in the more complete plants methods are introduced for aërating the water at the beginning of the process, and thus unloading it of a certain proportion of more or less foul gases which unite with pond or semi-stagnant water; and again at the end of the process, when both chemical and mechanical action have done their work, the intimate mixture of air serves to burn out the little that may remain of the albuminoid ammonia and dangerous living germs.

Mechanical filtration is no experiment, for we personally inspected, some years ago, a plant supplying over 2,000,000 galls. of water per day made pure by this process, and studied its operation, and can testify to its efficient and economical working; and, according to official reports lying before us, other plants of even greater capacity are "working splendidly." Under the conditions effecting so many convenient but more or less impure supplies, it is again to be wondered at that so little, comparatively, is done in extending the use of an American device that was first invented to meet just this emergency, and has gone through its hour of trial and proved its ability to do good work. From those who have used them we learn that the cost of a mechanical filtering plant is not half that of sand filters of equal capacity, and the maintenance cost is much less still in proportion. It is therefore not only more certain than older methods in really purifying water, but is also much cheaper, and there are doubtless many places in this country where the introduction of this process would secure good water where a natural supply of pure water would be prohibitory from its cost. In any event, the principle of mechanical filtration, and the various ingenious machines now available for this purpose, are worthy of fuller recognition by the hydraulic engineers of our country than is usually accorded them; and if this article will lead any of these engineers to fairly weigh it with other projects for supplying pure water under difficult conditions its purpose will be fulfilled.

The Laws of Air Resistance.

We completed last week the publication of a very curious and, if sound, revolutionary paper on the laws of air resistance, tending to show that within the limits experimented on atmospheric resistance did not increase as the square or the cube of the velocity, as has been heretofore assumed, and as in some cases it certainly does, and as theory and analogy with water seems to indicate that it should, but directly with the velocity; so that at 60 miles per hour the air resistance would be only twice what it is at 30 miles per hour, instead of four times or more, as commonly assumed; and so for other velocities.

The special merit of the experiments is that they covered an unusual range of velocities, running from 20 miles per hour up to as high as 130 miles per hour, and this in part by a very perfect apparatus for the end in view, the Weems electric railway, illustrated in our issue of Sept. 14, 1889, on behalf of which railway in fact the experiments were made, to see what resistances might be expected at heretofore unprecedented velocities for small vehicles, and what form would minimise them. As will be seen by referring to our account, the track on which the tests were made was about two miles in circumference, and over it a car about 2 x 2.5 ft. was run at times at the rate of 120 miles per hour, or one minute for the circuit, but in the air resistance tests, so far as recorded, the speed was only about half this. We made in our former article a brief approximate calculation of the air resistance at 120 miles per hour, and found it to be 120 lbs. out of a total apparent resistance of 187½ lbs., allowing only 21 lbs. per ton-train resistance for small cars at that high speed. This amounts to about 24 lbs. per sq. ft., and by referring to Fig. 2, published last week, it will be seen that Mr. CROSBY'S tests call for only 11 to 17 lbs. per sq. ft. Estimating train resistance at a larger and more probable amount, however, say 30 or 40 lbs. per ton, which we think to be a far more probable figure, the record becomes wholly consistent with Mr. CROSBY'S conclusions. A small vehicle such as described running over anything but perfect track, and with a top as well as bottom-rolling contact, would naturally have a high velocity, and moreover, our calculation included the internal friction of the electric machinery, so that these records are on the whole confirmatory of Mr. CROSBY'S conclusions for speeds of that rate. We may add also that if confirmed for 120 miles an hour, more or less, the case for the lower velocities is almost established, since the Smeaton formula, $R = 0.005\ V^2$, would give for the air resistance of such a vehicle as was used, 72 lbs. per sq. ft., or 367 lbs. in all, which is about double the total energy available for propelling the car. At such velocities, therefore, the Smeaton formula cannot be any where nearly true.



We give in the accompanying illustration, reproduced from our issue of Sept. 14, 1889, a drawing

of the car on which the car-tests were made. The gauge of the car is 2 ft. In addition to the rails shown a caging surrounded the car to guide it by the top rollers, from which the current of electricity was taken. All told, the resistance of the car must have been great.

Is it by possibility true that air resistance varies directly as the velocity? It certainly is a possibility, and for some reason it would almost seem to be a probability; but the conclusion can not be accepted until far more evidence is gathered in than now exists; certainly it can not be accepted on the strength of Mr. CROSBY'S experiments alone. Almost anything *may* prove to be true about air resistance, however, for it is a hard subject to experiment on accurately, and our real knowledge of its laws is yet but limited. It will at least be well to summarize the existing evidence *pro* and *con*.

The best evidence as to air resistance at very high speeds ought to be gunnery experience, with the drawback that experience with artillery projectiles is at such very high speeds as to afford a poor basis for determining resistances at any possible speed for vehicles. As to gunnery experience the Encyclopedia Britannica says (italics are ours):

Mathematics has hitherto proved unable to furnish complete formulæ satisfying the conditions. The resistance of the air to slow movements of, say, 10 ft. per second (6·7 miles per hour) *seems* to vary with the first power of the velocity. Above this the ratio increases and, *as in the case of the wind, is usually reckoned* to vary with the square of the velocity. Beyond this it increases still farther, till at 1,200 ft. per second the resistance is found to vary as the cube of the velocity. The ratio of increase after this point *is supposed* to diminish again, but thoroughly satisfactory data for its determination do not exist.

The same article on the next page says:

The most complete and valuable series of experiments yet carried out is that of Prof. BASHFORTH (1865 to 1870) at Woolwich and Shoeburyness. He found that, velocities and forms being equal and similar, the resistance varies exactly as the square of the diameter of the projectile (i. e., directly as the area). He further arrived at the conclusion that *between* 900 *and* 1,100 *ft. per sec.* R varies as v^2; between 1,100 and 1,350 ft. per sec., R varies as v^3, and above 1,350 ft. per sec. R varies as v^2.

What laws BASHFORTH established, if any, for velocities below 900 ft. per second, we do not know; we have not the report of his experiments at hand. But the general fact is clearly established by gunnery experience that the proper exponent for v varies with v; and if between 900 and 1,100 ft. per sec., it jumps from v^2 to v^3, it is a perfectly justifiable inference that for velocities falling below 900 ft. per sec. it may fall below v^2 No gunnery experiments, however, can be in themselves decisive as to velocities below 120 miles per hour or 180 ft. per sec. The part of the flight of a projectile which is made at less than four or five times this velocity is so exceedingly small that no trustworthy deductions from it can be expected.

As for observations on wind, they are well known to be highly untrustworthy. For some reason, doubtless in large part the great name of its author, the old Smeaton formula $R = 0.005\ V^2$, R being in lbs. per sq. ft. and V in miles per hour, has to this day maintained currency, and may be still called the standard; but it rested originally upon a very slim experimental basis, was by no means put forth as a finality by its author, and is quite certainly far in excess of all possibilities at the higher train speeds. This, at least, Mr. CROSBY has conclusively demonstrated by his experiments, running, as they do, up to much higher velocities than have heretofore been used for like tests. A further disproof is recorded in some train experiments by the present writer, recorded in a paper before the American Society of Civil Engineers (Trans. Am. Soc. C. E., Feb., 1879) which may be usefully quoted from in this connection.

Using Mr. CROSBY'S formula, $R = 0.131\ V$, for the like case, we should have

$$10.77\ V + (6 \times 9) = (14 \times 9)$$

whence $$V = \frac{72}{10.77} = 6.7$$

In other words, a single empty box car on a 0.7 grade would only attain a speed of 6.7 miles per hour before velocity would cease to increase, whereas it actually attained about 17.5 miles per hour, not only in one but many instances. On a 2 per cent. grade, giving 40 lbs. per ton accelerating force, the velocity attained would be

$$10.77\ V + (6 \times 9) = (40 \times 9)$$

whence $$V = \frac{306.}{10.77} = 28.4$$

This also is certainly too small, showing that the formula still does not give enough resistance. On a 4 per cent. grade we have

$$11.77\ V + (6 \times 9) = (80 \times 9)$$

whence $$V = \frac{666.}{10.77} = 61.7 \text{ miles per hour.}$$

This does not seem so far from the velocity which an empty box car would actually attain. Certainly it is much nearer than what is given by the Smeaton formula, which is:

$$.441\ V^2 + (6 \times 9) = (80 \times 9),$$

whence $$V^2 = \frac{666}{.441} = 1{,}505$$

and $$V = 38.79 \text{ miles per hour.}$$

The last is ridiculously small, showing that the Smeaton formula is at these speeds far out. But using one-third of the Smeaton coefficient, or 0.17 instead of 0.5 for 10 miles per hour, as advocated in the above extract, we should have:

$$V^2 = 4{,}515$$

and $$V = 67.19$$

This last corresponds closely with probabilities, and on the smaller velocities and grades gives results much more in accordance with known facts and probabilities than does the Crosby right line formula. Therefore, so far as railway vehicles are concerned, the error of the Smeaton formula would seem to be more in its coefficient than in its form, and the Crosby formula seems inadmissible.

But there may be causes incident to the deflection of the track and the oscillation and concussion resistances to modify this conclusion, and as the CROSBY tests extend up to very high velocities, we are unable to see where any such large source of error can exist in them, if correctly recorded, as to vitiate their results. By referring to Fig. 1 of our last issue, the tests will be seen to be wonderfully consistent with the right-line theory. Thus, line No. 1, for a normal plan is determined by *twelve* points between 11 and 130 miles per hour, all so nearly in a right line as to be almost suspiciously consistent with each other. No. 4 is determined by four points between 24 and 47 miles per hour; No. 5, by five points between 53 and 115 miles per hour, and so on. No sensible deviation from the right-line theory is discoverable anywhere; and not only does a right line pass almost exactly through all of the points, but these right lines in every case point directly to the common origin. It is an almost inconceivable hypothesis that this agreement can have come by chance. The good faith of these records must be impeached before the natural inference can be escaped as respects the small areas of 1 to 5 sq. ft. experimented on. What might be the result with larger areas we can only surmise.

Coming to the experimental proofs from railway records with which Mr. CROSBY closes his article, we must take some exceptions to them. For a nine-car train he figures out a total exposed area of 390 sq. ft. This we are disposed to regard as far too large. It amounts to nearly three times the area exposed by a single box car. As a consequence, at 52 miles per hour, he shows that the various accepted formulas use up nearly all the actual energy of the locomotive to overcome air resistance alone, his own formula using only about half of it. But if we reduce his assumed areas by about one-half, as seems to us fair, the recorded resistances are not so very inconsistent with the older formulas after all.

The only conclusion we can draw from these tests, therefore, is to echo Mr. CROSBY'S own closing words:

Although the experimental results here recorded seem trustworthy, and cannot now be distinctly overthrown or set aside, yet, by reason of the great conflict of evidence, this important matter of atmospheric pressure calls for a very extended and careful series of tests. The cost of determining formulæ true beyond any question would be repaid many times every year in applying them to the true economy of engineering structures.

We will end by suggesting what seems to us the best, if not the only way of bringing this vexed question to something like certainty. Take one or two unloaded flat cars with bearings in first rate condition. Find also a piece of straight track on at least a 1 per cent. grade, and as much more as possible, and determine by the gravity method, as described in detail in the paper above quoted from, precisely what the resistance of the empty flat cars is, up to as high velocities as they will obtain on the given grade. All this is a simple and inexpensive matter.

Then erect on the flat car areas of various sizes and forms, some solid, some broken, some reticulated, some mere wrie net-work, etc. The weight of these will not sensibly modify resistance of the car except as they modify air resistance, especially as a little pig iron will keep the weight constant in all the tests. Therefore, all increased resistance noted at any given velocity will be due to the added air resistance, and if the grade be only steep enough, a very considerable range of velocities will be obtained. The grade should preferably be at leased 1¼ per cent. and should not be less than 0.7 per cent. or the cars will not start readily. Of course only calm days should be used for the tests.

If there be any young man among our readers anxious to distinguish himself, here is his opportunity. The expenses involved are very slight beyond the occasional use of a switch engine and a mile or two of track, and this, if he be in earnest and competent, he can obtain by suitable application, from almost any of the large companies, free or cost.

Notes from Abroad.

[EDITORIAL CORRESPONDENCE.]

THE S. S. "CITY OF NEW YORK."

The Inman line steamship *City of New York* is now the largest ship afloat, her sister ship, the *City of Paris* being laid up for repairs. She is 565 ft. long, 63¼ ft. beam, and 42 ft. deep; tonnage, 10,500; H. P., 20,000. She was built on the Clyde, at the works of J. & P. Thompson, and is now in her third season. She is propelled by twin screws, driven by a pair of triple expansion engines, to which steam is supplied by nine boilers arranged in three batteries. There are three iron masts, without sails; and three tall smokestacks of oval section. All the hoisting machinery is operated by hydraulic power; the cylinders and plungers for each separate plant are attached to the swinging looms which project over the cargo hatches. The anchor winch is also operated by hydraulic power, the large wheel over which the chain cable passes being driven by worm gearing. Below the upper deck there is very little natural ventilation owing to the transverse bulkheads which divide the deck into separate sections without intercommunication. Artificial ventilation is supplied by fans which drive a stream of cool fresh air into each stateroom; the mouth of the pipe is covered by a double fixed and sliding grating, so that the supply can be regulated to suit the occupants of each room.

The advantages of a large ship in point of steadiness were very clearly shown at Queenstown. Lying at anchor in the lower bay, some distance below the city, the steamer was perfectly steady. The rather small, side-wheel tender, however

showed the extent of the swell by plunging and lurching violently as she lay alongside. When she started back for Queenstown and went bobbing up and down in the bay, she seemed to offer more opportunities for seasickness in that short trip than the big boat had offered during her Atlantic passage.

LANDING ARRANGEMENTS AT LIVERPOOL.

The bar at the mouth of the Mersey is the cause of continual delay, inconvenience and annoyance to the passengers of large steamers, but no steps appear to be even proposed for deepening the water on the bar. When, as is frequently the case, and as was the case with the *City of New York*, a steamer arrives when the tide does not serve, the landing arrangements are most primitive and inconvenient, and often form the worst experience of the voyage. The steamer lay at anchor some distance out, and three or four moderate sized tenders came alongside. These are side-wheel steamers, with open decks, which are not extended on "guards" to the outer side of the paddle boxes. On one of these boats the mails were placed, on the open deck. The cabin passengers' baggage was then put on another tender, being slid down an inclined gangway to the bridge or hurricane deck of the tender and then down another gangway to the deck, where it was stowed forward under a canvas awning. A passenger gangway was then placed from the promenade deck of the steamer to the top of the paddle box of the tender, and down this the passengers came with more or less (generally less) dignity and comfort. Looking up from the tender it seemed a wretchedly managed and arranged affair, with plenty of chances for loss of baggage or injury to passengers. Fortunately the water was smooth and the weather fine. In rough weather the passengers must wait until the steamer can cross the bar, but even then they usually disembark into tenders; in case of rain they must descend the wet and dirty gangway and stand on the open deck during the trip to the landing stage. It is presumably a time-honored custom, but one which would be better honored in the breach than in the observance. Tenders with covered decks and commodious gangways would be a good investment. However, in this instance all was accomplished without mishap, though with many expressions of wonder and indignation, and after a run of nearly two hours, the passengers and baggage were disembarked on the Prince's landing stage.

ENGLISH RAILWAY ITEMS.

When taking a special steamship express over the London & Northwestern Ry., there was little or no confusion, the porters (clad in brown corduroy) and other officials (clad in dark blue frock coats with silver buttons and facings and silver mounted caps) quickly getting the passengers into the first, second or third class compartments, and answering all questions satisfactorily and courteously. After two or three false alarms by shrill whistles from the engine, the guard sounded a whistle like a boatswain's call, and waved a green flag. The porters closed all the doors, the engine whistled again and the train started, gliding smoothly out of the station. "Gliding" is the word which exactly expresses the movement of the train in starting; the moment of starting is imperceptible, the cars run very smoothly, and all the couplings are screwed up tight. The speed was high and the noise considerable at times, owing partly, I believe, to the absence of a non-conducting packing in the sides and floor of the car. No long stop was made for dinner, but luncheon baskets could be ordered at Liverpool, Crewe or Rugby. The number of bridges is very large, owing to the absence of road crossings; and I particularly noticed several footbridges across the track at places where there were paths across the fields. The approaches are a flight of steps in the masonry abutments on each side. The running is controlled entirely by the block signals, but the train was only delayed once or twice. For the greater part of the distance there are four tracks, and one set of signals is distinguished by a white ring on the semaphore blade, the diameter of the ring being about twice the width of the blade. The blades are of steel, with two lengthwise corrugations. The signal rods are angle irons of small section. The freight trains I saw were all hauled by engines of the type almost universally adopted in England for freight service, namely, with six wheels, all coupled. The engines of this road are painted black, relieved by a little red and white striping and a little brass. At one place where a fence had been made of wooden ties placed on end I was interested in noting that the ties were pretty deeply cut by the cast-iron rail chairs, which had a base of probably about 7 × 14 ins.; of course I do not know how long they had been in service or what amount of traffic had passed over them. This seems to indicate, however, that the use of tie-plates under flange rails in America may not be so beneficial as has generally been supposed; but it would depend largely on the amount of traffic. At switches and crossings the ends of the guard rails are let into blocks made from old ties. The "goods wagons" are small (15 ft. being about the longest), and the majority of them are open, with low sides; the box-cars are low and short; all these cars are carried on two rigid axles. Some of the freight cabooses or "vans" are open at the ends, with high sides and doors round the open platforms. The freight cars are usually painted gray, black or brown, with the name of the private owner or initials of the railway company in large letters on the sides.

The passenger cars of the London & Northwestern Ry. have the lower part of the body, up to the windowsills, painted a purplish brown. The upper part is white with narrow gold striping. On the Midland Ry. the engines are painted dark red or brown and the cars are a dark crimson, picked out with gold and black striping. All the stations have high platforms, nearly level with the floors of the cars. Communication between the platforms is effected by means of bridges or subways. At some places horses are employed for hauling cars in switching and making up trains. There are not many opportunities for examining the track at stations. In America one can step off the car on to the track and get right on again as the train starts. In England you would have to jump down from the platform and scramble up again in time to find your car and compartment before the porter shuts the doors and the guard blows his whistle. Of course, if the train makes a comparatively long stop you can walk away to the ramp or incline at the end of the platform. The train was a special one, and is therefore not in the time-table, but the running was as follows (Rugby not noted):

Liverpool (Lime St.)	4.45	....
Crewe	5.40	42.75 miles.
Rugby	....	118.20 "
Willesden Junction	9.03	....
London (Euston)	9.15	200.75 miles.

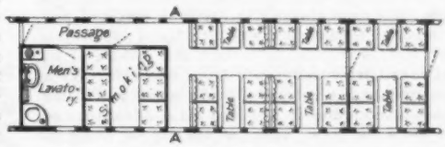
An average of 44.61 miles per hour.

AN "ANGLO-AMERICAN" CAR.

The car in which I traveled from Liverpool to London was a decided surprise to me, being a saloon car instead of the compartment car generally used in England. It was not open from end to end, but was divided into large and small compartments, with doors in the partitions. I did not examine it closely, and had no rule, but I give below a sketch of the part which I investigated. The car was considerably narrower than an American car, and it will be noticed that, while the seats on one side of the gangway are wide enough for two passengers, those on the other side are only wide enough for one passenger.

The doors are marked by blank spaces, the windows by a blank space with a line across. The only doors of this part of the car that were open at the time were at *A* and *A*. The others were locked, and had narrow green baize-covered tables fitted against them. The roof was low and slightly arched. The interior was not attractive. The upholstering was in dark blue cloth, while the sides and roof were covered with material resembling papier-maché, with a raised pattern of papier-maché apparently. This was of a cream color, with light brown moldings at the sides and round the door. The moldings were flat, and the whole effect had an unsubstantial appearance, so that every time the door in the partition was opened and closed one involuntarily expected to see the partition buckle and sway like a stage scene. The floor was carpeted, and there were two lamps in the large compartment; but the light was wretchedly bad. The seats were too low and too soft for comfort, but had high backs and head rests. On the side at each seat was a heavily padded strap, looped up, forming an arm rest such as used to add to the gloom of the old-time English mourning coaches. The windows at the seats were fixed, but the doors had sliding sashes, which dropped into the lower part of the door when the window was open. A strap attached to the bottom of the sash had holes to engage with a stud on the door, so that the opening of the window could be regulated to a few inches. Spring-roller shades were fitted to the windows.

The gentlemen's lavatory was not so handsomely appointed as those on American cars (especially Pullman, Wagner or other palace cars), but it was more roomy. A water-closet with double seat and a good flush of water was in one corner. Against the partition was a "folding lavatory;" after use it is shut up, the contents being discharged into a pipe leading below the floor. It is entirely of metal, and in order to prevent the contents from slopping over on the floor the edge of the basin is bent down inside. Over the basin was a mirror, with a tray for a brush and comb. In a brass rack was a supply of clean towels, folded up, and when used they were hung on hooks against the partition. In one corner was a glass and a small bottle of drinking water; no ice. The window was of ground glass. The door had a brass label on each side with "pull" or "push," as the case might be; and each tap of the folding lavatory was similarly marked. The floor was covered with linoleum or floor-cloth. There is an attendant (a white man, in uniform) to each car of this kind (which is for first-class passengers only), and at each side of each compartment is an electric button, with a label over it "To call the attendant." The label has a cheap and old-fashioned appearance, consistent with the general interior effect of the car. Before leaving Liverpool the attendant booked orders for lunch baskets, which were delivered at Crewe or Rugby, as desired. The basket is of wicker-work, and contains a hot or cold lunch, according to order; in the main part of the basket is the meat on a plate and with a paper napkin (bearing, like everything else in the car, including the carpet, the company's mark); with this is a very common iron knife and fork with yellow bone handles. A couple of rolls, a little porcelain double dish with butter and cheese, a similar dish with mustard and salt, and a bottle of claret or beer completes the supply. For this a charge of three shillings (75 cts.) is made. Tea or coffee can be supplied by the attendant during the run. Near the end of the journey the attendant requests permission to dust the passenger's hat and coat, and gives the passenger a polite "thank you" if this permission is granted; then he does not stand around obviously expectant of a tip, but if he gets it takes it rather as an unusual mark of favor. While the car and its appointments were decidedly inferior to the first-class cars of American railways, and while the lunch service was decidedly inferior to the buffet or dining car of American railways, the car was, on the whole, a great improvement upon the generally used compartment car of English railways, in which the passenger is confined without a chance to stretch himself or get away from undesirable neighbors. From former experiences of these compartment cars, I was the more able to appreciate the advantages of lavatory conveniences on an English car.



An English Saloon Car.

CORRESPONDENCE.

The New York Rapid Transit Problem.

NEW YORK, June 11, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The problem to-day of most importance to this great metropolitan city is to continue to furnish the best facilities for export and import, together with rapid transit of passengers and freight, for her largely increasing population. Is the great question not better solved by putting an elevated railroad around the entire island over the front streets, including North, East and Harlem Rivers? A belt road, in fact, that would have two tracks for express passenger trains, and two for local, then two or more for freight that should be utilized, with turnouts to every shipping pier along the entire front, and for local depots interior for distribution or receipt of freight from local merchants? Such a road should whirl the through

passengers between the limits of the city in ten to twelve minutes.

The Island, long and narrow, with reasonable cross town facilities, would enable almost every person to reach his home in the most remote part of the island in less than half an hour. Feeders made eventually to such line from north of Harlem River would open up the whole taxable property of New York State to residences as no other system can.

Assuming that we have solved the rapid transit question for passengers, let us consider the greater commercial interests of our people in freight transportation therewith. Every ocean receiving or shipping pier could have side tracks, to or from which full or partly loaded cars could be run, the freight elevated on board and dispatched much more quickly than by the present drayage, and at far less cost. Every railroad entering Jersey City could have some form of elevated incline to take freight cars on an upper deck for delivering to any part of such a belt road, and this freight could be received or delivered to or from any convenient location, for either shippers or merchants, at less than one-fourth the present cost of carting. I believe we may safely say it costs more to cart our meat and flour to-day from the merchant's house to our home than is charged for bringing it 1,000 miles to our city. We should see all the railroads doing business with this city, securing locations on this island for connections with such a road, and the road itself anxious to transport it to or from convenient locations, when the haul would only be across town, saving much to every consumer, as also the wear and tear of the streets.

If New York is to control her great commercial interests, as against all other coast distributing and receiving points, she must occupy this field now. If correct, what better work for ENGINEERING NEWS than to give a map showing all this? A. W. S.

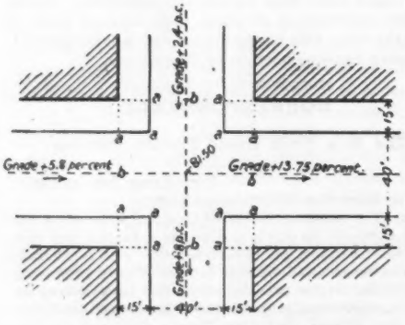
[It hardly needs a map to show that this plan has much to commend it, and that it will be carried out some day we do not doubt. But we think we can suggest to our correspondent the reason why capitalists are not just now competing for the privilege of constructing it. It is for the same reason that the belt lines of horse cars which now run over the same route have almost the thinnest traffic of any in the city; because it skirts the edge of population only, instead of running through the middle of it, and so can draw traffic only from one side. As a consequence, the volume of traffic which will come to it is much reduced, and the main advantage of the route for New York would be to bring in suburban trains on, or trains from the far uptown districts. Of this traffic there is a large amount to be secured or developed, but the interior lines must always be the more profitable, and so the more eagerly sought. As for the possible freight traffic, there is no doubt a good deal of it, but the difficulties are great; the main one being that it is hard to avoid all teaming, and when goods must be loaded up to haul a quarter of a mile they can almost as cheaply be hauled four or five miles. ED. ENG. NEWS.]

Grades at Street Intersections.

MISSOURI VALLEY, Ia., May 22, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Enclosed please find a plot showing the intersection of two streets with the grades, curb lines, etc. The question is: What should be the elevation of grade at the points in the curb lines marked *a*; and what should be the elevation on the street lines at the points marked *b*? Perhaps some of your readers will answer through the columns of the NEWS. W.



Grades at Street Intersections.

[This is a frequent and awkward problem. When complicated by buildings already erected, the grades must often be adapted as closely as possible to the buildings as they stand. When otherwise, it seems to us that the safest rule is: use such grades that the central rectangle *a a a a* shall *appear* to be nearly level, but to secure this it must actually have a considerable dip in the direction of the slope of the street; and when both the intersecting streets have a steep slope this brings one corner decidedly lower than the other. If the central square be made actually level it will inevitably seem to slope in the opposite direction, and give an awkward and ungainly effect. There ought to be some established rule for such intersections, but we know of none. It would seem at first sight as if a general rule of *one-third* the general slope of the street in each direction, or of the average slope, if the grade breaks at the street, might give a good effect; but we cannot speak of this from actual observation. This would give for the grade of the 40 ft. square *a a a a* in our illustration, $\frac{\frac{1}{3} \times 2.4 + 8.0}{2} = 1.73$ per cent. up and down, and crosswise: $\frac{\frac{1}{3} \times 5.8 + 13.75}{2}$ =3.26 per cent. From this, given anyone fixed elevation, the entire curb grade is readily figured. The slight difference of level of the curbs, when blocks are short, may advantageously be left to take care of itself, running straight grades on each side of the street from curb corner to curb corner, regardless of having the opposite curbs of the street precisely level. Sidewalks under all circumstances, where there is danger of ice and snow, should have a very slight transverse grade, not over 4 to 6 ins. in 10 ft. Otherwise they become dangerous in icy weather and unpleasant at all times. At the corners of the streets this is particularly necessary.—ED. ENG. NEWS.]

Rail Base Plates.

LONDON, June 4, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have read with great interest in your issue of May 24 a notice of the Holgate tie plate, and as you have been good enough to publish several of my designs and articles on the same subject, I hope you will find room for the following remarks:

Your readers will find the Holgate tie plate resembling one of my earliest designs, published in your journal some time ago. The latest was published in the fall of last year. You will observe that I adopted the fixing of the rail flange by keys to the sole plate instead of spikes. My reason for so doing was that with spikes and holes in the plate it requires an almost absolute correctness of width of rail base and corresponding holes in the plate. This is in practice very difficult to obtain. I am inspecting similar work now for one of the Scandinavian State Railways, and have done so for several years, and I must say I have no inspection work that troubles me more. I am sure the makers will corroborate this statement. With keys, a variance in width of rail base of 1/16 in., or even 1/4 is of no influence for the object in view; and, as to the keys becoming loose, there is experience of more than half a million tons of rails being fixed to metal sleepers with keys with a satisfactory result. As for fixing the plate to the tie, spikes or bolts can be used according to the engineer's choice.

You will observe that my last plate is 12x8 ins., or 96 sq. ins., corresponding to the base of the cast iron chair used in England with so much success, while the Holgate tie plate is 7x8 ins., giving 56 sq. ins.; and that the thickness of my plate is 1/2 in., instead of 1/4 in. in the Holgate. Now the Holgate plate is hardly double the surface of the rail base on the tie, and therefore to my mind not of sufficient area, and the inconvenience of a larger plate soon being bent would be prevented by making it of an adequate thickness. The placing of the Holgate plates on the rack, so as to change individual sleepers easily, is very good, but the same object can be obtained more quickly by using keys for fixing the rail flange to the plate, which can then be fixed to the tie in advance. The arguments in all respects for preserving the tie and keeping the gauge, in Mr. Holgate's letter, I can only endorse most heartily, as I have stated the same repeatedly, and first in my paper before the Institution of Civil Engineers. "On the Use of Heavier Rails" last year, from which it might be concluded that base plates or sole plates have to come, and therefore we had better make the best of it.

I may add that a mile of road is now laid with my Goliath Rails and base plates on the Furness Ry. The result is so far satisfactory, and the trial is going to be extended for the sake of comparison with their English type of road. Any further contributions like that of Mr. Holgate's cannot be but welcome to your readers, at least on the continent of Europe. C. P. SANDBERG.

"A Question in Town Surveying."

GREAT FALLS, Mont., June 6, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of May 24 I see a long communication from W. E KERN, of this city, in regard to a resurvey of the town which I have about completed, and as about all of his statements in the matter are a long way from true, I trust you will kindly allow me a space in your valuable paper to correct them.

He makes the statement that the actual distance between the monument at Second and Fifth Sts. on Central Ave. is 1,292 ft., and that I have increased this to 1,294 ft. But I have only increased it to 1,292.1 ft., and, as this distance is three blocks and there are seven lots to a block fronting on the avenue, it makes the excess just 0.1 ft. per lot, the recorded distance being 1,290 ft. I send you a plot of the ground between and including Second and Fifth Sts. from Central Ave. to Tenth Ave. south, showing old and new monuments and changes made by me.

Mr. KERN also states that I have located these monuments arbitrarily. This is untrue, as the matter was brought up before the Council and a committee appointed by them to act in conjunction with the Park Commissioners and myself to decide on the method of making the resurvey; and after doing preliminary work enough to see where the errors in the old survey were, and then consulting with several prominent attorneys, including our city attorney, it was decided that the corrections as I show you on plot would be perfectly legal, and the proper way to dispose of the excess, and the Council passed a resolution ordering the work so done.

Now, Mr. Editor, as you have commented on Mr. KERN'S side of the question I trust you will do likewise by me for if I am in error in all of my work I wish to know it.

E. W. KING.

[The papers sent by Mr. KING put quite a different face on the matter; which, as we discussed it, however, related merely to the general question of what could be done to correct discrepancies of monuments. We are obliged to excise from the above letter certain personal paragraphs in reply to a sentence in Mr. KERN'S letter, which we regret we allowed to remain, and should not have done, except that it purported to record admitted facts. Mr. KING had just cause to complain of it, and to reply to it; but we think his letter as above is sufficient reply.—ED. ENG. NEWS.]

A New Use for Ear Wax.

MINNEAPOLIS, MINN., June 12, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In running a railway line in the Minnesota pinery, 60 miles from a railway, and 200 from an instrument-maker, after a hard storm followed by bright sunshine, the levelman came up with the refreshing intelligence that the hairs had gone out of the level. We were three miles from camp and everything at a standstill. I started every man in the party with a wooden fork to get spiders web, straightened out a shoe buttoner on a stump for an adjusting pin, took out the ring with the buttoner, aided by a penknife for a screw driver, and fastened the web to the ring with *ear-wax*, adjusted, and went to work; all of which took just 40 minutes. And as I used the level steadily for two weeks and am using it yet, I conclude the operation was a success. Moral: "Carry ear-wax."

E. T. ABBOTT.

[Balsám gum, or the gum from almost any coniferous tree, will answer very well for this use; but we have never before heard of such a use for ear-wax.—ED. ENG. NEWS.]

Notes and Queries.

A correspondent writes: I am anxious to learn the latest and best practice in laying out, measuring and finishing race tracks. If you know of any publications containing such information, I shall be indebted to you if you will let me know of it, and where I can obtain a copy. [Some good papers have been written, but we do not recall their titles.]

I would like also to obtain information concerning the use of asphalt in lining reservoir basins I understand that the material alone, properly prepared, and mixed with sand and coal tar, is used for such a purpose, and on earth foundations, proving clean and water-tight, and successfully resisting considerable pressure. If you know of any such use having been made of this material, I shall be obliged if you will let me know the places where it has been used, and the sources from which I would be likely to obtain detailed information relative to the work.

BRICK FOR PAVEMENT has been adopted in Des Moines, Ia., after several years' trial of cedar blocks and other materials.

Braced Iron Towers.

I. C. E. P.

Although there are examples of almost any kind of framed structures and their proper treatments for finding the strains caused by the external loading scattered through a great many standard works, yet there is not one to be found giving a method of treatment for a structure of a complex figure composed of more than four posts or columns in a tower under the two different cases of loading, one from its own and superimposed weight or dead load acting vertically downward, and the other from a wind force acting transversly upon the structure. The crude manner in which it is very often attempted to calculate the strains for such structures even by so-called experts will justify the publication of the case under consideration, since it will be of general interest to the engineering fraternity at large inasmuch as it will show by what simple methods a seemingly complex case may be solved, conditioned on the *proper conception* of the case on hand.

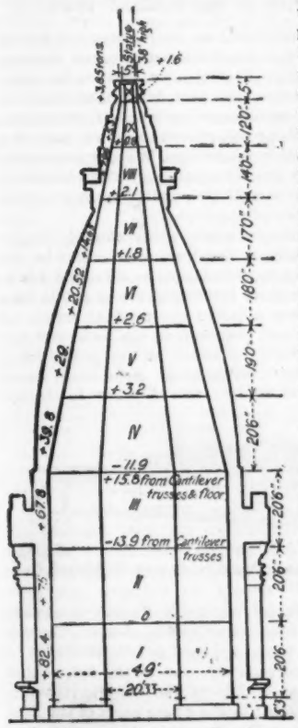


Fig. 1.

The structure under consideration is the dome of an immense tower rising from an altitude of 337 ft. above the ground level to a height of 173 ft. from its base to the crowning figure at its apex. It consists of an outer shell or covering of cast iron and aluminum bronze, which, in turn, is connected to and supported by a main frame of 8 wrought iron columns.

The lower part accommodating the clock story with its four clock faces of 23 ft. diam., which are surmounted by immense pediments resting on highly ornamental columns and pilasters, rises vertically for 67 ft., from which point it forms a perfect octagon, converging at the apex under the surmounting figure, the supporting frame forming an octagon in turn as per accompanying figures. For the proper determination of the internal strains in the members of the main-supporting frame, it is necessary to consider its construction as to how the external loads are to be supported.

As shown in sketch, the whole structure is divided into 10 sections or panels from base to apex, and it is intended to so connect the outer shell to the main frame of 8 columns as to practically concentrate the total loads for each section at their panel points, from which it will appear that either one of the 8 columns will carry one-eighth of the total load, consisting of the weights of the shell and the weight of construction, from the apex to point under consideration. These loads were taken at 20 lbs. per sq. ft. for the shell and 15 lbs. per sq. ft. for the construction, including secondary trusses, etc., and from which loads result the compressive strains in the 8 columns, as shown on skeleton figure.

For a clear understanding of the case it must be mentioned, that with the exception of a floor carried by cantilever trusses at the 67 ft. level, and another one at height of the balcony or lookout at the eighth section level, there is no inside bracing of the structure.

In considering the proper method of how to arrive at the correct strains from the external forces, it was held by an "expert" that the problem could be *correctly* solved by the graphical method alone, but the writer, after exchanging views with a number of engineers, to one of whom, Mr. E. SCHMITT, he is especially indebted for valuable suggestions, became firmly settled in his conclusion that the problem cannot be solved *properly* by the graphical method, without arriving at grossly erroneous results.

The graphical method so far as this case is concerned could only be employed in a limited way, as to the finding of the strains from dead load and for the strains caused by the wind force in the struts and diagonals of the two panels parallel to the

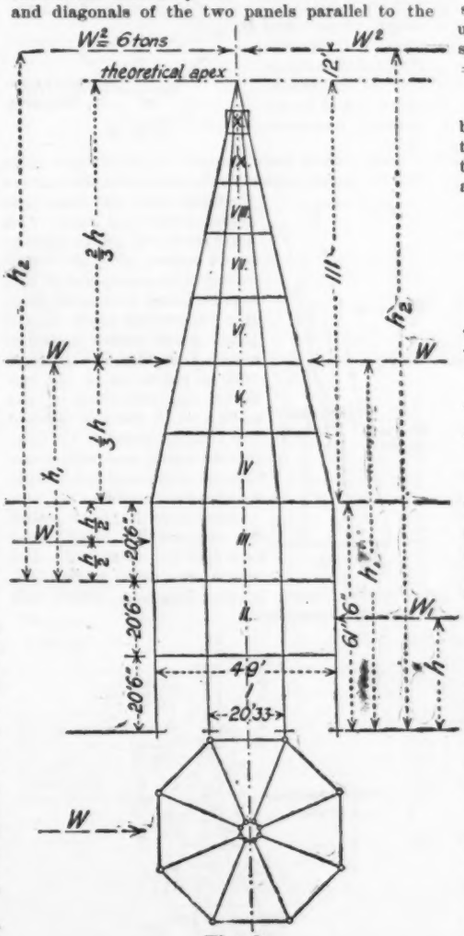


Fig. 2.

direction of the wind only, but not for the strains in the flanges or main columns proper. The reason, roughly speaking, is that in trying to arrive at the strains by the graphical method alone, which can only be done by treating one panel of the eight as a cantilever fixed at one end, the resistance of the whole figure of an octagon is simply reduced from a diameter of 49 ft. to one of 20.33 ft. Therefore, it is obvious that the case has to be treated by the analytical method, and furthermore that the frame work of eight columns has to be *conceived as a unit* resisting with its total area the transverse action of the wind force. Consequently in general terms the moment of resistance of the whole structure at each point under consideration must be equal the external moment caused by the wind force $R = M$ from which follows that the corresponding strains $S = \frac{M}{R}$.

These strains will be tension on the wind side and compression on the leeward side, and in magnitude must be in proportion to their distances from the neutral axis of the whole structure, under right angles to the action of the wind force. These strains combined with the strains from dead load with due regard to their properties as to plus compression and minus tension (±) will give the ultimate strains in the eight columns. Ultimately all eight columns will have to be proportioned in accordance with the greatest strains produced, since the wind shifting to all sides will cause the same strains in either one in rotation. In the following the treatment and its correctness and simplicity will speak for itself.

Beginning at the apex there is a wind force of 6 tons acting at the center of gravity of the surmounting statue 17′ 6″ from the top, as per accompanying sketch, consequently $M = 17.5 \times 6 = 105$ feet tons.

It is obvious from the plan of the structure, an exact octagon, that the four S are equal to each other and also the 4 S°, as their relative positions in regard to axis x-x under wind force are the same, consequently since $R = M$,

$$R = 4\,S \times \frac{D}{2} + 4\,S^\circ \times \frac{d}{2}$$

but since the relation of S to S° must be as their distances from the neutra axis,

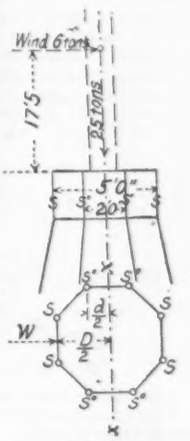


Fig. 3.

$$\therefore S^\circ : S = 1 : 2.5 = S^\circ = \frac{1}{2.5}\,S = \frac{S}{5} \times 2 = 0.4\,S$$

$\therefore R = 4\,S \times 2.5 + 4\,S^\circ \times 1$, and since $S^\circ = 0.4\,S$

$\therefore R = 10\,S + 4 \times 0.4\,S = 11.6\,S$; then since $R = M$

$= 11.6\,S = 105$ feet tons

$$\therefore S = \frac{105}{11.6} = \pm 9.05 \text{ tons and since } S^\circ = 0.4\,S$$

$\therefore S^\circ = \pm 3.62$ tons, tension on wind side and compression on leeward side from wind.

The dead load from the crowning statue being 2 tons, makes a compressive strain of $\frac{25}{8} = 3.125$ ton for each column, and the ultimate strains under combined loads will be as follows for all eight columns

	S	S°	S°	S
from wind	= − 9.05,	− 3.62,	+ 3.62,	+ 9.05 tons
" dead load	= + 3.125,	+ 3.125,	+ 3.125,	+ 3.125 "
	− 5.926,	− 0.495,	+ 6.745,	+12.175 "

resultant strains, whence follows that the eight columns for this section would have to be proportioned to resist a compressive strain of + 12.175 tons, and a tensile strain of − 5.925 tons.

The external moments M for the pyramidal part of the frame are to be found as per following: In a triangle equally loaded the resultant acts at a point one-third of the entire height from the base as per sketch, and it follows that the moment M for any panel point of the pyramidal part of the structure will be:

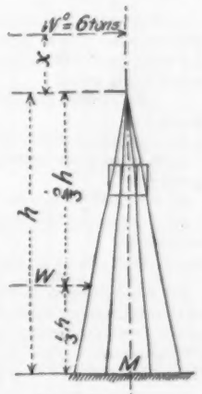


Fig. 4.

$M = W \times \frac{1}{3}\,h + W^\circ \times (n + x)$, where h = height from panel point under consideration to the theoretical apex, and x distance to wind force, $W^\circ = 6$ tons acting at center of gravity of crowning statue, and W the total wind force; this force W, in regard to each panel point, is to be computed as per following:

w_1 = wind force normal to face.

a = side of panel, h = height from theoretical apex, therefore:

$w_1 = \frac{a\,h}{2} \times p$; p = wind force at 30 lbs. per sq. ft.

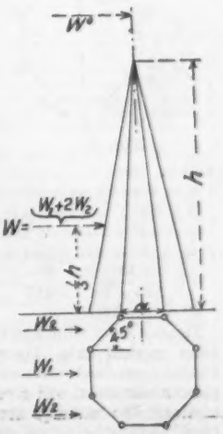


Fig. 5.

w_2 or wind force on inclined sides.

$w_2 = \frac{a\,h}{2}\,p \times (\text{cos. } 45^\circ)^2$

$= \frac{a\,h}{2} \times p \times 0.3535$ and the total wind force

$w = w_1 + 2\,w_2$

$w = 0.8535\,a \times h \times p$

$w = 42.7 \times a \times h \times$ ∴ say $43 \times a \times h$

The moments of resistance and the resultant stresses S produced by these moments will be calculated as follows:

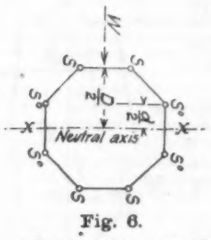


Fig. 6.

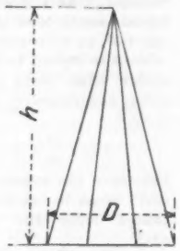


Fig. 7.

All eight columns acting as a unit in their ratio of their distances from the neutral axis x—x under consideration therefore;

$S^o : \frac{d}{2} = S : \frac{D}{2} = S^o : S^o{}_1 = S\frac{d}{D}$ and since for our regular polygon: $\frac{d}{D} = \frac{20.33}{49} = 0.4149$ therefore $S^o = 0.4149\,S$, and the moment of resistance of the 4 columns S and 4 columns S^o must be =

$R = 4\,S \times \frac{D}{2} + 4\,S^o \times \frac{d}{2}$

$= 2\,S \times D + 2\,s^o \times d$, but since $S^o = 0.4149\,S$ and $d = 0.4149$, D is

$= 2\,S\,(D + d)$

$= 2\,S \times 1.4149\,D$

and ultimately $R = 2.83\,S \times D$, but since for any panel point D may be expressed in its relation to h in the ratio of height to diameter.

∴ $D = h \times \frac{49}{111} = 0.4418\,h$, consequently

∴ $R = 2.83\,S \times 0.4418\,h$, or lastly

∴ $R = 1.25\,S \times h$ and since in general

$R = M$

$= 1.25 \times h \times S = M$, therefore

$S = \frac{M}{1.25\,h}$ and

$S^o = 0.4149\,S$. Tension on wind side and compression on other side of the neutral axis. The moment for any panel of the lower perpendicular part of the structure is when:

w = total wind force on upper part to theoretical apex.

h_1 = point of action of force w.

w_1 = wind force acting on respective section of lower part.

h = height of section.

h_2 = distance of action of wind force w^2 on crowning statue.

Then: $M = w_1 \times \frac{h}{2} + w \times h_1 + w^2 \times h_2$.

The wind force w_1 is the sum of the wind acting on the side under right angles to same and of wind on the two sides under an angle of $45^\circ = w_1 = w + 2\,w^o$ whence

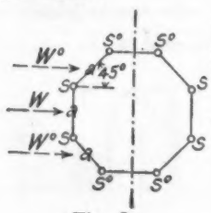


Fig. 8.

$w = a \times h \times p$.

$w^o = a \times h \times p = (\text{cos. } 45^\circ)^3\,a\,h\,p = 0.3535$ therefore

$w_1 = a \times h \times p + 2 \times (a \times h \times p \times 0.3535)$

$= 1.71 \times a \times h \times p$ (p = 50 lbs. per sq. ft.)

= (21.9 tons for section under consideration).

S the resultant strains will be, since

$R = M$ and R as before found is

$R = 2.83\,S \times D$ then it is

$= 2.83\,S \times D = M$ and since for the lower part D is constant and equal to 49', so is

$S = \frac{M}{2.83 \times 49} = \frac{M}{138.97}$ and

$S^o = S \times 0.4149$

Tension from wind and compression on other side from neutral axis. These strains added to the strains from dead load, as shown at beginning, for panel under apex, will give the ultimate resultant strains. The ultimate tension caused from wind force, and to be taken up by the anchor bolts will be strain S at foot of column, and is, as per above:

$S = \frac{M}{R} = \frac{w_1 \times h + w \times h_1 \times w^2 \times h_2}{R}$

Against this strain there is ⅙ of the weight of the whole tower acting, which will be compressive, and combined with strain S will give resultant strain either plus or minus (±). Substituting the numerical values in our example, we have:

$\frac{66 \times 30.75 + 60 \times 98.5 + 6 \times 184.5}{130} = -65.1$ tons.

The dead load being + 82.4 tons.

− 65.1 "

+ 17.3 tons,

which show that there is no tensile strain, and so far as this is concerned there would be no necessity for anchor bolts.

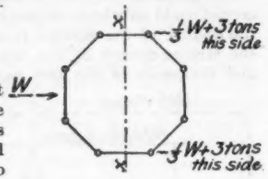


Fig. 9.

Besides these main stresses in the columns, there will be strains created in the horizontal members of the frame from the transverse action of the wind force. This wind force will be the same as found before, plus the 6 tons acting in crowning statue, and is in each case to be taken from the theoretical apex to the panel point under consideration. One third of this force will be taken up by the columns, and two-thirds of the same pass to the two sides of the octagon parallel to direction of wind, and will, therefore, be compression in members between columns.

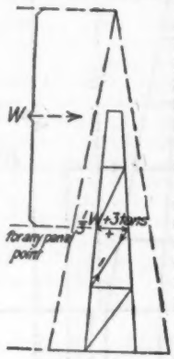


Fig. 10.

To this force has to be added the compression from dead load, and the total, with due regard to their inclination, will cause tension in the diagonals, which will be arranged crosswise.

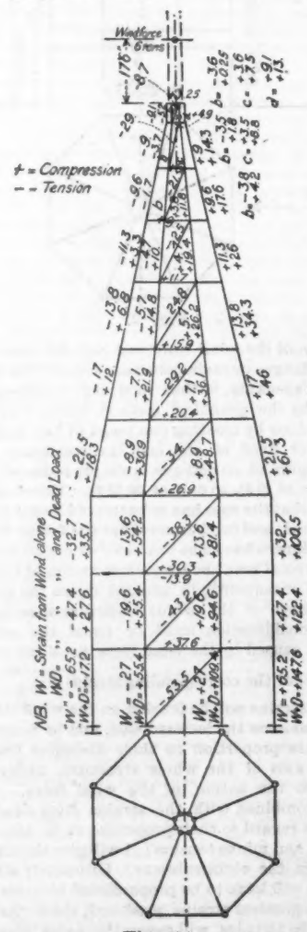


Fig. 11.

The distortion caused by the wind force, which could not be taken up and resisted by the struts and diagonals, from the nature of the structure, would be considerable and would amount to about 21% of the total wind force; but, as mentioned in the introductory remarks, there will be two floors in this case, by means of which this defect will be reduced to a minimum, and will be entirely eliminated by the secondary construction to support the outer shell. In conclusion, the writer wishes to say that he is far from decrying the value of the graphical method, but is of the opinion that in important cases of a complex nature the two *methods* ought to be employed to prove the correctness of the results of either one.

The View of the Oakland Draw.

In our issue of June 7 we gave a map and description of the great drawbridge disaster at Oakland, Cal., opposite San Francisco, as sent us by one of our subscribers on the spot, who immediately investigated the occurrence in our behalf, as we desire and request all our subscribers to do who may be in the vicinity of such occurrences. We now supplement this account by the accompanying little view, which we reconstruct as well as possible from a newspaper sketch from a photograph.

The view shows, as words alone cannot, the perfectly clear view of the draw which could be had from the approach, and this view extended for no less a distance than three quarters of a mile from the bridge, as was noted in our original article. A more striking proof that human vigilance and eyesight alone cannot be relied on as a protection in such cases we have rarely seen. Sometimes the so-called "careless' neglect to see what is straight

Sketch showing Drawbridge at Oakland, Cal.

before one's eyes (an inevitable human weakness) happens in one way, sometimes in another. In this case it seems to have happened as follows:

The curve, unfortunately, was *to the left*, so that on the engineman's side of the cab the view was somewhat obstructed by the upper parts of the locomotive, and only on the fireman's side was it perfectly clear. The engineman, therefore, was not watching very carefully, depending on the fireman to warn him, as he himself admits, and as he claims is a general custom among enginemen, no doubt, with some truth. The fireman was not running the engine, and not specially asked to look out at this point, and so he did not do so. Between these two human stools, all caution fell to the ground.

The only danger signal displayed at the draw, or required to be displayed, was the usual flagman's red flag stuck in the last tie of the approach, just at the end of the draw. The view of this was much obstructed by the truss, as can be readily understood from our sketch, and it was not until the engine was right upon it, say 200 ft. off, that it became clearly visible. There is some dispute as to whether even this signal was in position, but whether it was or not does not much matter. It was so poorly placed as to be almost useless at best. The draw is not used very much, which in reality made it all the more dangerous; but it is hard to get that view accepted.

INTERESTING STATISTICS IN REGARD TO THE LIGHTING OF PARIS were given at the last meeting of the *Societe Internationale des Electriciens* by M. Fontaine, the president. He stated that while the consumption of tallow for candle-making had fallen from 1,200 tons in 1855 to 300 tons last year, the number of candles other than tallow had also declined from 220 burned per head of the population in 1855 to 190 per head last year. The use of petroleum is rapidly superseding that of vegetable oil for lighting purposes, the consumption of the former being as four gallons to one. The quantity of gas burned has risen from 105,000,000 cubic meters in 1887 and 1°2,000,000 in 1883 to 189,000,000, while the applications of the electric light, which did not exceed 22,

of 230 H. P. in 1887, had risen to over 500 with 17,400 H. P. last year, this being exclusive of the electric light used in the exhibition. It is estimated that in two years time, when the central stations are completed in Paris, the total amount of horse-power will have risen to 32,000. Even now the electric light is distributed by 6,800 arc regulators and 118,000 incandescent lamps, while if gas supplies 573-1,000 of the total lighting of the city the electric light shows already a proportion of 189-1,000.

THE NEW CROTON AQUEDUCT was opened on June 18, and Commissioner GILROY can now withdraw his notices requesting the public to use the water supply as if it were a priceless article. From 1870 to 1886 the old aqueduct has brought about 94,750,000 galls. to the city each day, while the annexed district has drawn its supply from the Bronx River. The total amount which could be brought into the city was about 100,000,000 galls., and as the new reservoir in Central Park has a capacity of only 1,200,000,000 galls., the city would have had but 12 days' supply on hand (and really much less, owing to depletion) had the old aqueduct given way. There was plenty of water back of the Croton dam, 175,000,000 galls. running to waste daily, but it could not be brought to the city with the facilities at hand.

For more than 20 years remedies were sought for the existing evils, but it was only in the spring of 1883 that the new aqueduct was authorized. Engineers NEWTON and CHURCH estimated the cost of the work as follows:

Quaker Bridge dam and reservoir	$4,000,000
140,311 ft. of aqueduct from dam to Harlem River, $60 per ft.	8,418,660
2,320 ft. tunnel across Harlem River	232,000
11,986 ft. of aqueduct, from Harlem River to Manhattan Valley	599,300
4,000 ft. iron siphons across Manhattan Valley	374,000
Gate house connected with siphons	100,000
9,783 ft. of aqueduct, Manhattan Valley to Central Park	586,080
Gate house and connections, Central Park	100,000
4 waste gates between Harlem River and dam	50,000
	$14,460,040

In August, 1883, the Commissioners began to work; in November, 1884, proposals for the construction were invited, and in December, 1884, the work was awarded to Brown, Howard & Co., O'Brien & Clark, Smith & Brown, and John Brunton & Co. The length of the line is 33⅛ miles, divided as follows:

	Miles.
From Croton Dam to Harlem River	28¼
From easterly shore Harlem River to gate house at 135th St.	2⅛
Total of tunnel	30¾
Pipe line from 135th St. to Central Park reservoir, 12,525 ft.	2⅜
Aggregate length of aqueduct	33⅛

Within a month after the contracts were awarded 23 of the 24 shafts above the Harlem River were started. There were 38 shafts in all, the deepest being 350 and the least 28 ft.

THE AQUEDUCT ENDS at 135th St. and Convent Ave., where a gate house has been built for the purpose of distributing the water properly through the eight 48-in. pipes which receive it at this place.

The capacity of the Central Park reservoir is about 1,200,000,000 galls. Hitherto it has been dependent upon the old aqueduct for its supply, with the addition of a small supply spared from the Bronx works. The inflow has, however, never exceeded 100,000,000 galls. daily. With that inflow the reservoir has not been full since 1875, and frequently during hot seasons, as now, it has fallen alarmingly low. But with the additional supply now to be fed to it, it is confidently expected that it will rapidly fill to its capacity and permit of a full pressure being put upon the distributing pipes leading from it, so that all portions of the city will at once receive relief.

Up to June 1, $21,781,620 has been paid out for the work. The Vyrnwy aqueduct, supplying Liverpool, 68.25 miles long and supplying 40,000,000 galls. daily, cost $9,064,875.

During the progress of the new Croton aqueduct there have been 97 deaths among officers and workmen employed, caused by premature explosions, falling rocks and similar accidents.

THE THREATENED ICE FAMINE in New York City and the neighboring cities which depend for their upply of ice upon the Hudson River crop has created a great demand for plants for the manufacture of artificial ice, and inquiry as to its cost as compared with the natural product. There are now only about six companies of any prominence which manufacture plants for making artificial ice in this country, and these are now working double time in order to supply the demand. According to the best authorities the artificial ice companies cannot, unless they have some special features, manufacture and sell their ice in New York City at less than $2 per ton. The cost of Hudson River ice under especially favorable conditions is from $1 to $1.25 per ton laid down at the docks, and the cost of the best Maine lake ice is only $2.50 per ton laid down at the docks. The artificial ice companies, then, can just about compete with the natural ice companies when the Hudson River crop is good. The artificial product is much purer than the natural product, and is generally to be preferred. Great care must be taken, however, in its manufacture to prevent its contamination by the chemicals used in the process, and when manufactured it does not last as long as the natural product, and cannot be stored for any length of time.

Elements of Weather in the United States, of Most Interest to Engineers, for the Month of May, 1890.
[Furnished to ENGINEERING NEWS by the Chief Signal Officer, U. S. A.]

STATION	Temperature. (Deg. Fah.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Maxim.	Direction at time of max. velocity.	Precipitation.—Rain and melted snow. Inches. Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.										
Northfield, Vt.	51.8	73	24	49	9.7	48	SW	4.32	0.98	16
Portland, Me.	52 0	75	36	39	9.1	37	SE	6.10	1.93	17
New York City	60.6	80	42	38	10.0	36	W	3.11	0.56	15
Pittsburg, Pa.	62.0	86	37	49	4.4	25	N	5.85	0.83	20
Chicago, Ill.	53.4	86	34	52	18.2	59	NE	5.13	2.60	16
Omaha, Neb.	60.1	89	33	56	10.4	40	NW	2.72	0.52	12
St. Paul, Minn	52.2	86	27	59	7.8	35	NW	3.66	0.73	14
Duluth, Minn.	43.2	76	29	47	6.9	27	SW	2.24	0 57	17
Bismarck, N. Dak.	51.3	83	27	56	15.4	60	NW	0.57	0.18	9
Average	54.1	81.6	32.1	49.5	10 2	40.8	.....	3.74	0.99	15.1
SOUTHERN CITIES.										
Washington City	64.0	86	42	44	6.0	32	NW	4.73	1 03	16
Louisville, Ky.	64.7	88	39	49	7.0	30	SW	3.15	0 91	11
St. Louis, Mo.	63 8	90	37	53	11.4	49	S	5.81	2 38	15
Savannah, Ga.	73.0	89	51	38	7.3	35	SW	3.13	0.88	12
Leavenworth, Kan.	63.0	88	36	52	7.7	30	SW	4.10	1.61	18
Jacksonville, Fla.	74.4	89	53	36	7.8	31	SW	9.20	3.71	16
Chattanooga, Tenn.	68.0	89	40	49	4.3	27	NW	3.95	0.85	13
New Orleans, La.	74.4	87	59	28	7.7	35	NW	5.32	1.71	14
Memphis, Tenn.	69.4	89	48	41	6.6	42	NW	4.42	0.86	12
Palestine, Tex.	72.3	88	5	38	5.0	24	N	6.85	3.04	10
Average	68.7	88.3	45 5	42.8	7.1	33.5	.....	5.07	1 70	13.7
WESTERN CITIES.										
Helena, Mont.	54.0	82	32	50	8.0	36	W	1.43	0.36	17
Port Angeles, Wash.	*	*	*	*	*	*	*	*	*	*
San Francisco, Cal.	59.8	85	47	38	9.7	36	SW	1.07	0.53	4
Salt Lake City, Utah	61.3	84	40	44	5.7	26	SE	0.16	0.08	3
Denver, Col.	57.7	85	32	53	7.0	36	N	2.01	0.72	14
Yuma, Ariz.	78.0	106	54	52	7.5	36	W	0.00	0.00	0
Santa Fé, N. Mex.	59.3	80	37	43	8.2	35	SW	†	†	0
Average	61.7	87.0	60.3	46.7	7.7	35.8	.....	0.78	0.28	6 3

* Report not yet received. † Trace.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Salisbury & Harvey.—This Nova Scotia railway has been sold to the National Improvement Co., of New York City, for $70,000. The purchasers have secured valuable manganese mines in Albert Co., and the road will be extended to them.

New York Central & Hudson River.—About $2,500,000 of the proceeds of the new $15,000,000 issue of New York Central bonds will be used in depressing the acres of the Central's tracks that skirt the eastern section of Buffalo. For a long distance these tracks run through thickly-settled neighborhoods and cross important business thoroughfares. In pursuance of a law passed by the State Legislature requiring all tracks entering Buffalo to be depressed, the Vanderbilt roads have contracted with that city to pay their proportionate share in sinking the tracks below the surface of the streets. A great union station will also be erected to take the place of the present New York Central station on Exchange St., between Michigan and Main Sts. This work will be begun just as soon as the necessary agreements and contracts have been secured from all of the railroad companies interested.

Philadelphia & Seashore.—This New Jersey road has been completed to Tuckahoe, 10 miles north of Sea Isle City. The rolling stock has arrived, and this portion of the line will be put in operation at once. The road is to run from Winslow to Sea Isle City, 35 miles. G. A. Benson, of Philadelphia, is Chief Engineer.

Baltimore & Ohio.—It is announced that this company will begin work shortly on a line from Uniontown, Pa., to Morgantown, W. Va., a distance of about 24 miles.

Herkimer, Newport & Poland Narrow Gauge.—Press dispatches state that a movement is on foot to purchase this narrow gauge railway running from Herkimer to Poland, N. Y., about 17 miles. It is the intention to change the road to standard gauge, and extend it north to the Adirondacks.

New York, Susquehanna & Western.—Surveys are in progress under the direction of W. E. King, for the proposed line from Stockholm Station, N. J., to Bryam's Cove, Lake Hopatcong, a distance of about 12 miles. The estimated cost of the branch is $200,000.

Pennsylvania.—This company will build a short branch from McKeesport, Pa., to Bridgeport, in the Chartiers Valley.

Escanaba, Iron Mt. & Western.—G. M. Willis, of Iron Mt., Mich., Chief Engineer writes as follows:

This railway is to run from Escanaba, Mich., via Iron Mountain, Mich., and Florence, Wis., to Crystal Falls, Mich., a distance of 100 miles. The line has been located and the contracts for construction let to McIntosh Bros., of Milwaukee, Wis., who are to have the road completed by Oct. 1, 1890. The route is through a heavily timbered country, maximum grade 26 ft. per mile, and maximum curve 3°. The principal business of the road will be in iron ore and it is expected that it will be in operation by May 1, 1891. The company was chartered Jan. 21, 1890.

Coudersport & Port Allegheny.—B. A. McClure, General Superintendent, writes us as follows:

Grattan & Co., of Buffalo, N. Y., have the contract for the proposed extension from Coudersport to Sweden Valley, 40 miles, and about 300 men are now at work on the line. Two and one-half miles of the grading have been completed and about ¼ mile of track has been laid. The line will ultimately be extended from Sweden Valley to Ansonia. The principal business of the road will be in lumber and bark.

New York, Ontario & Western.—The Ontario, Carbondale & Scranton R. R. is rapidly approaching completion. The section between Hancock, N. Y., and Carbondale, Pa., a distance of 40 miles, is now practically completed, and the remaining distance of 14 miles is being rapidly finished. The total length of the line is 54.37 miles, and it is expected that it will be completed by July 4. There is considerable heavy work on the lines, including the construction of the iron bridge across the

Delaware River at Hancock, and the large trestle across the morass at Starbird's Station.

Baltimore & Ohio.—The citizens of Cumberland, Md., have voted in favor of the proposition to lend the city's credit to this company for $150,000 in consideration of the location of its shops there, and making the city a division terminus. The plan of the new stock issue by the company has been decided upon. Details will be found in our "Engineering News" columns.

Somerset.—Work is being rapidly pushed on the extension from Carratunk Falls to Bingham, Me.

Kennebec Central.—This Maine road running from Randolph to Togus, Me., is practically completed and will be in operation by July 1.

Projects and Surveys.

Johnsonville & Rutland.—Chartered in New York to build a railway from Johnsonville to Granville, N. Y., a distance of 96 miles. It is proposed to build new road from Granville to Greenwich, and from that point the Greenwich Johnsonville R. R. will be used. Among the incorporators are: Geo. Hill, A. H. King, Wm. H. Wiley and others.

Easton & Northern.—Chas. Goldsborough, of Easton, Md., Chief Engineer, writes us that nothing has been done beyond a consideration of the proposition to construct by the projectors of the proposed railway from Easton to Chestertown, Md. The route of the proposed line is through a fine agricultural country.

Saranac & Lake Placid.—Incorporated in New York to build a railway from the southern terminus of the Chateaugay R. R. in Harrietstown to the village of Lake Placid, a distance of 10 miles. Among the incoporators are: Smith M. Weed, Legrand B. Cannon and Alvin L. Inman.

Skowhegan & Norridgewock.—The incorporators of this company, at a recent meeting, accepted the charter granted by the last legislature, and appointed a committee to carry out the preliminary work necessary to the early commencement of construction.

Grand Rapids, Chicago & St Louis.—The survey of this road has been completed. The road runs from Grand Rapids to Benton Harbor, Mich., 80 miles. Wm. M. Laughlin, of Grand Rapids, is Chief Engineer.

SOUTHERN.—Existing Roads.

Columbia, Newberry & Laurens.—Tracklaying is in progress on the 10-mile section between Prosperity and Newberry, S. C.

Norfolk & Western.—This company has purchased the Scioto Valley & New England R. R., and will hereafter operate it as a portion of its system. The road runs from Petersburg, O., to Columbus, O., a distance of 125 miles, and the company has a projected extension of about 120 miles to Ft. Wayne, Ind. The N. & W. will connect with its purchase by the Elkhorn extension to Ironton, O., now in process of construction.

Jacksonville, Tampa & Key West.—Articles of consolidation of this company and the Atlantic Coast, St. Johns & Indian River and the Sanford & Lake Eustis railway companies have been filed.

Carolina, Knoxville & Western.—A movement is being made by the towns along the route to resuscitate this enterprise. The road is projected to run from Augusta, Ga., to Knoxville, Tenn., and about 17 miles have been completed from Greenville, S. C., north. It is stated that the towns along the line are willing to subscribe liberally in aid of the enterprise.

Georgia Southern & Florida.—J. S. McTighe, of Macon, Ga., will sublet the contracts for constructing 200 miles of the Macon & Atlantic R. R., in 5, 10 and 20 mile sections. Address J. S. McTighe & Co., 316 Pine St., Macon, Ga.

Memphis & Charleston.—A meeting of the stockholders of this company will be held July 9 to consider the advisability of increasing the capital stock of the company, purchasing and building lines of railway and making other improvements.

Alabama Midland.—The grading on the Montgomery, Tuscaloosa & Memphis R. R. between Montgomery and Maplesville, Ala., is nearly completed, and work has been commenced on the division from Maplesville to Tuscaloosa, Ala. Tracklaying will be commenced soon.

Georgia Southern & Florida.—Wm. H. Wells, of Macon, Ga, Chief Engineer, writes as follows:

The Macon & Atlantic R. R. is projected as the western extension of the Macon & Birmingham R. R., and will run from Macon, Ga., to Savannah, Ga., a distance of 159 miles. The preliminary surveys have all been completed, and two corps are now locating the line. The work is medium; maximum grade, 52 ft. per mile, and maximum curve, 3°. There will be drawbridges over the Ocmulgee and Oconee rivers. The contract has been let to J. S. McTighe & Co., of Memphis, Tenn., who have already commenced work. Tracklaying will commence in about 1 month, and the road is to be completed, ready for traffic and turned over to the company in 8 months, averaging 1 mile of completed road for each working day. The construction of the line will be under the direction of the Chief Engineer.

East Tennessee, Virginia & Georgia.—A correspondent writes as follows concerning the Johnson City & Carolina R. R.:

This road is projected to run from Johnson City to Asheville, N. C., but only the portion from Johnson City to Embreville, Tenn., will be built at present. Purdy & Rexford, of New York City, have the contract, and are now at work on the line. Tracklaying is to begin Aug. 15, and the road is to be completed by Nov. 15. G. Morris, of Johnson City, Tenn., is the engineer in charge of construction.

Projects and Surveys.

Tallahassee Northern.—This company has been chartered to build a railway from Tallahassee, Fla., north to some point in Georgia. The incorporators are: Charles H. Bennett, R. L. Bennett, both of Philadelphia, and Geo. W. Saxon, B. A. Meginniss, and Geo. Greenhow, all of Tallahassee.

South Brunswick & Calahan.—Chartered in Georgia to build a line of railway from South Brunswick, Ga., to Calahan, Fla. Among those interested are: Jas. B. Scott, Henry R. Symons, John E. du Bignon and J. M. Maddon.

Abbeville & Tifton.—This company has been chartered in Georgia to build a railway from Abbeville to Tifton, Ga., a distance of about 50 miles. Among the incorporators are: Henry E. Perkins, of Richmond, Va., R. D. Worthen, of Washington, D. C., and Charles Hicks, of Laurens, S. C.

Virginia, Missouri & Western.—The prospectus of this road recently issued gives the route of the line as from Norfolk, Va., to Iscilita, N. M., and the estimated cost of construction as $70,000,000. It does not state, however, where the money to build the road is to come from.

Columbia, Geneva & Western.—A correspondent writes as follows:

The preliminary survey is now being made for this road, which is projected to run from Columbia, Ala., via Sanders, to Geneva, Ala., a distance of 50 miles. The route is through a finely timbered and good agricultural section of the State. The principal business will be in cotton, naval stores, timber and general merchandise. About $120,000 of the capital stock have been subscribed by the people along the route. The company was chartered April 30, 1890. H. L. Collier is Chief Engineer and Capt. John T. Davis is at the head of the enterprise. The principal offices are at Columbia, Ala.

NORTHWEST.—Existing Roads.

Chicago, Peoria & St. Louis.—D. W. Rider, Jacksonville, Ill., Superintendent, writes as follows:

About 30 miles of the grading have been completed, and 22 miles of track have been laid on the extension from Litchfield to East St. Louis, Ill., a distance of 48 miles. The route is through a fine agricultural and coal region, affording easy grades and curves. There will be one pile-trestle bridge 800 ft. long and 40 ft. high, the others being small. E. M. Collins, of Edwardsville, Ill., has the contract for building the line.

Winona & Southwestern.—This company has let the contract for 10 miles of its extension to the Iowa State line to Dennis Galligan, and bids are now being asked for a further extension of 20 miles, and the contract will probably be let soon. Bids for bridging the entire 30 miles have been asked for.

Northern Pacific.—The announcement is made that this company has secured by purchase the Chicago & Calumet Terminal R. R., and has also concluded traffic arrangements with the Milwaukee & Northern R. R., whereby a line is obtained to the Lake Superior iron regions.

Great Northwest Central.—J. H. E. Secretan, of Brandon, Man., Chief Engineer, writes us as follows:

About 200 men and 100 teams and two ballast trains are now at work ballasting the 50 miles of track already completed from Brandon northwest. This section will be opened for traffic about August 1. The locating survey has been completed for 100 miles additional of the road, and preliminary surveys have been completed for 150 miles further. The contracts will be let immediately for the 100 miles which have been located. The total length of the road will be 450 miles, and it will run from Brandon to Battleford, Man. The route is through a fine prairie country, which it is expected will furnish a large grain traffic. There will be two bridges across the South and North Saskatchewan rivers, 1,000 ft. long and 2,100 ft. long, respectively. The work is generally light; maximum grade 60 ft. per mile and maximum curve 6°. The company has a land grant of 6,400 acres per mile from the Dominion Government.

Projects and Surveys.

Chicago, Baraboo & Northern.—Chas. Junge, Secretary, Baraboo, Wis, writes us that this road is to run from Jefferson, Wis., via Columbia and Sauk Center, to Kilbourne, Wis. The line will be nearly straight with no heavy work. Frank Avery is President.

Kickapoo Valley & Northern.—The town of Forest, Richland County, Wis., has voted $10,000 in aid of this enterprise.

Duluth Transfer.—The articles of incorporation of this company have been filed. The object of the company is to construct a transfer railway in St. Louis County, Minn. The officers are: Albert Harrington, President; Chas. E. Lovett, Vice-President; Omar H. Simonds, Secretary, and Daniel H. Merritt, Treasurer.

Bismarck & Galveston.—Articles of incorporation have been filed for a standard-gauge railway 2,000 miles in length. The proposed line is to be build from Bismarck, N. D., to Galveston, passing through Republic, Salina, McPherson, Harvey, Sedgwick and Sumner counties, Kansas. The capital stock is named at $10,000,000. The directors are C. Risemeyer, Jr., J. Winkler, J. D. Long, W. F. Genene and James Daw, all of Halstead, Kan.

SOUTHWEST.—Existing Roads.

Wichita Valley.—This road has been opened for traffic from Wichita falls to Dundee, Tex., a distance of 27 miles, and work is now being rapidly pushed on the line to Seymour.

Texas Western.—This narrow gauge Texas road running from Houston to Sealey, Tex., a distance of 53 miles which was recently purchased by Elijah Smith, will, it is stated, be changed to standard gauge and possibly extended.

San Antonio & Aransas Pass.—The location of the line from Houston, Tex., to Alexandria, La., has been completed. The route is through a fine pine timber region.

Kansas City, Wyandotte & Northwestern.—This road has been sold to Jay Gould for $650,000.

Cleveland, St. Louis & Kansas City.—A new company is to be organized by the purchasers of this road which, it is stated, will proceed with the construction of the line.

Projects and Surveys.

Manhattan, Newton & Gulf.—Chartered in Kansas to build a railway from Manhattan, Kan., southwest to the Gulf of Mexico, a distance of about 1,000 miles. Among the incorporators are: A. R. Williams, of Topeka, Kan.; John C. Johnston, of Newton, Kan., and S. M. Fox, of Manhattan, Kan.

Two Towns Ry. & Navigation Co.—This company has been chartered in Arkansas to build a railway 9 miles long from Texarkana to Sulphur River. J. H. Draughton, J. H. Bemis and others are interested.

ROCKY MOUNTAIN AND PACIFIC.—Existing Roads.

Oregon & Washington Territory. A force of about 600 men are now at work on the line from Centralia to Gray's Harbor. Additional forces will be put on, and it is expected to have the line completed by Nov. 1.

Northern Pacific.—Chief Engineer Kendrick has awarded the contract for building this company's new passenger depot at Spokane Falls to Deeks & Witbeck, of St. Paul. The contract price is $45,000. The building is to be of pressed brick, with brown stone trimmings, and two stories high. Its dimensions are to be 160 by 50 ft.

A press dispatch from St. Paul, Minn., quotes President Oakes as saying: "We have made an arrangement with the Seattle, Lake Shore & Eastern road for the use of 20 miles of its track around Lake Washington. This road has a line on the west side of the lake while we are building on the east. Under the new arrangement we will use its tracks and they can use ours. The two lines together will then form a belt line around Seattle, and it is simply a mutual arrangement for the benefit of both companies."

Southern Pacific.—The contract for building the line from Merced to Oakdale, Cal., 40 miles, has been let to Turton & Knox, of Sacramento, Cal. Work will soon commence at Merced and the road completed this season.

Pecos Valley.—Tracklaying is reported in progress on this New Mexico road.

Canadian Pacific.—C. E. Perry, of Enderly, B. C., Chief Engineer, writes as follows concerning the Shuswap & Okanagan Ry.:

The road is to run from Sicamous, B. C., via Enderly and Vernon to Okanagan Lake, a distance of 15 miles. The surveys are nearly completed. The route is through an agricultural and mining country, and the work will be generally medium or light, with only about 15 miles of heavy work; maximum grade 1%, and maximum curve 9°. The principal business of the road will be in general passenger and freight traffic, with large shipments of live stock. It is expected that the road will be completed by the end of 1891. Nearly all of the right of way has been secured. The Provincial Government guarantees 4% on $1,250,000 for 25 years, and the Dominion Government gives $3,200 per mile in aid of the road. The Canadian Pacific has leased the road for 25 years, paying 40% of the gross earnings as rental.

Projects and Surveys.

San de Fuca Ship Canal & Railway Co.—W. P. Mason, of Seattle, Wash., Chief Engineer, writes us as follows:

This company was chartered to build a ship canal from Penn's Cove, on Puget Sound, across Whidby Island, to the Strait of Juan de Fuca, a distance of 1½ miles, and to build a line of railway from the eastern terminus of the canal to the main land, via Hope Island, connecting with the Seattle & Northern and Canadian Pacific railways. The survey for the canal has been completed and the contract for clearing let to Harlan & Hartail. The survey for the railway, which will be 40 miles long, is now in progress. Howard C. Walters, of Seattle, Wash., is interested.

Butte City, National Park & Southern.—Incorporated in Montana to build a railway from Butte southwest via Deer Creek and Pipestone Pass to Jefferson Valley and thence via Jefferson and Ruby valleys to Ennis, in Madison Valley.

Denver Resort.—This company has filed articles of incorporation in Colorado. The company was organized in connection with the Denver Resort Co., which was fully described in our issue of March 8.

Northern Pacific & Northern Idaho.—This company has been chartered in Washington by John M. Mitchell, W. O. Chapman, H. S. Hanson and J. B. Williams, to build a railway from some point on the Spokane Falls & Northern R. R., via Moscow and Cornwall to Lake Waha, in Idaho.

Helena & Castle Mt.—A committee of Helena, Mont., citizens has been appointed to confer with the officials of the Northern Pacific R. R. in relation to building the branch from Helena to the Castle Mountain silver and lead mining district.

Colorado Utah & Pacific.—This company has been chartered to build a railway from Denver, Colo., to Ogden, Utah. Considerable surveying is said to have been done on the line. The incorporators are: Jas. McLean, W. D. Lowe, W. D. Suydam and B. F. Nicas.

Lookout Mountain Resort.—This company, it is stated, has its arrangements nearly completed for com-

mencing construction. The line is to run from Denver, Colo., to the summit of Lookout Mountain.

Seattle & Montana.—Contracts will, it is stated, be let for the construction of this road shortly. The survey has been completed from Seattle east to the mountains.

FOREIGN.

Mexican International.—The time for commencing work on the San Benito & Tapachula Ry. has been extended 2½ years.

Laguna.—The location of this road has been completed. It is to run from Hornos to San Pedro de Laguna, Mex., and will be very easy to construct.

RAPID TRANSIT.

Cable Railways.—The Piedmont (Cal.) Cable Co. has recommenced its excavations on Fourteenth St. The work on the whole line is now almost finished. Twelve combination cars have been contracted for with the John Hammond Co.

The Houston, West St. & Pavonia Ferry R. R. Co., of New York, with a capital stock of $250,000 has leased the Broadway & Seventh Ave. R. R. Co. and all its leased branches. The stock of the latter corporation is $2,100,000. The agreement carries with it the proposed increasing of the capital stock of the Houston & West St. line from $250,000 to $5,000,000. The consolidation was accomplished to facilitate the laying of a cable on Broadway and Seventh Ave. Daniel Lamont is President of the Houston, West St. & Pavonia Ferry R. R.

At San Francisco, Cal., the North Beach & Mission St. car line will soon be replaced by a cable road at an estimated cost of $2,000,000 for changes in equipment and construction of road-bed.

Horse Railways.—A Nashville syndicate has purchased the street railway system of Savannah, Ga.

At Denver, Col., H. A. W. Tabor, J. H. Poole and A. C. Fisk, as directors, recently incorporated the Denver Resort Ry. Co., with a capital of $250,000.

The surveys of the Columbus, Ind., street railway have been begun, and the contractors, Scoll & Lyle, promise that 3.5 miles will be finished within 60 days.

The new proprietors of the Naumkeag street railway recently organized at Salem, Mass., and appointed Benjamin Orne, President, and J. F. Hickey, General Manager and Treasurer.

The street railway of Laconia, N. H., is being rapidly pushed; cars, however, are now run over but part of the line.

The sale of the street-car system of Louisville, Ky., has been consummated, and a syndicate composed of E. E. Denniston, E. W. Clark & Co., of Philadelphia; J. V. W. Seligman & Co., of New York; Kidder, Peabody & Co., of New York, and Brown Brothers & Co., of New York, now own the 151 miles of roads. The price paid was $4,000,000.

The Rochester, (N. Y.) Ry. Co. has applied to the city authorities for the right to construct a double surface line of considerable length.

New transfer plans have been made by the Detroit City Ry. Co.

At St. Paul, Minn., a single track line is being built on Robert St.

About 2¼ miles of track will be laid at once in Batesville, Ark.

Ground has been broken for the Baton Rouge, La., Ry. on Government St.

The Laramie, (Wyo.) Street Ry. Co. has been incorporated; capital, $100,000.

The Broad St. R. R. Co., of New York, has been formed with a capital of $300,000 for constructing and operating a street surface railroad, beginning at the northerly end of the present ferryhouse at South Ferry, thence with double tracks along Whitehall, South and Broad Sts., thence with single track through Wall, William and North William Sts., thence along Park Row to and along Nassau St. to a junction with the westerly tracks upon Broad St. A branch line will also be constructed, beginning upon Spruce St. at the intersection of William St., and connecting with single track upon William St., along Spruce St., with single track to Nassau St., connecting with single track upon Nassau St., thence with double track, connected with the single track, upon Nassau St., across Nassau St. and along Printing House Sq., with double track to and across Park Row to and along Mail St., to the termination of Mail St. near Broadway. The directors of the company for the first year are: Harry B. Collins, of Islip, L. I.; Robert L. Cutting, Harry K. Knapp, William F. Havemeyer and Charles C. Eddy, of New York; Robert A. C. Smith, of Brooklyn, and H. J. Nicholas, of Babylon, L. I.

The following officers have been chosen by the stockholders of the Twenty-third St. Ry. in New York: President, W. L. Elkins; Vice-President, P. A. B. Widener; Secretary, Thomas H. McLean; Treasurer, Walter H. Hatch.

Electric Railways.—The street railway company of Greenville, S. C., has received a $300,000 franchise for putting in an electric railway system.

An electric railway will be built in Knightstown, Ind. by Eastern capitalists.

The Brooklyn City R. R. Co., and the Coney Island & R. R. Co., have applied to the Common Council for leave to use electricity as a motive power. The Atlantic Ave. system has had a similar application on file for some time.

The Cicero & Proviso Street R. R. Co., of Chicago, has applied to the city authorities for a permit to lay tracks for an electric street car line in that portion of the city formerly a portion of Cicero.

An ordinance has been presented to the City Council of Allegheny, Pa., granting the right of way to a new electric road. The company is known as the North Allegheny Electric Street Ry. Co. Jas. Breen, George W. Snaman, Henry Schwitter and others are interested in the project.

The East St. Louis (Ill.) Electric Street Ry. Co. has begun to build its lines.

The contracts for the Duluth (Minn.) electric street lines have been let as follows: The electric contract, to the Thomson-Houston Co.; engines, E. P. Allis & Co.; rails, Johnson & Co.

The coming State Fair at St. Paul, Minn., will be made accessible from either that city or Minneapolis by two new electric roads, which will be completed some time before the fair is opened.

The Belt Line of Savannah, Ga., has petitioned the City Council to allow them to operate the road by electricity.

E. P. Shaw and W. B. Ferguson are starting an electric route between Lawrence and Haverhill, Mass.

The Adams Co. has been incorporated at Chicago to purchase or control patents for, build, or construct electric and elevated railways; capital stock, $200,000; incorporators, J. W. Adams, C. W. Griggs and G. M. Harris.

HIGHWAYS.

Washington.—A toll road will be built from Hood City to Mineral Springs, Wash., by the Olympic Post Road Co., of Seattle.

Colorado.—At a meeting of the County Commissioners of Leadville, it was decided to macadamize the big Stray Horse road ½ mile at a cost of $1,500.

Rhode Island.—A preliminary survey has been made at Newport for the proposed boulevard along Easton's Pond.

Maine.—The Robinson Mfg. Co. recently flooded a large tract of country near Otisfield, paying about $17,000 for the privilege. A number of old highways were rendered useless and new ones will be built.

Minnesota.—Surveys will be made at once for a boulevard to connect St. Paul and Lake Como.

Florida.—The rock road from Gainesville to Rocky Point will cost about $5,000, of which $3,000 are already subscribed.

Massachusetts.—At Boston, Mass., Blakeville St. from Bowdoin St. to Olney St., is to be laid out as a highway.

John E. Bell & Co., of Washington, who have recently made large investments in Montgomery Co., Md., real estate along the Georgetown and Rockville turnpike, have secured a controlling interest in the turnpike company, with a view to regrading the old roadbed to accommodate the extension of the electric railroad from Tenallytown to Rockville.

Rhode Island.—The Town of Lincoln has appropriated $30,000 for highways and bridges.

WATER-WORKS.

NEW ENGLAND.

Bethel, Me.—The Bethel Water Co. is making arrangements to commence work on the dam. The order for new pipe has been placed. The estimated cost of the new works is $35,000. The town will pay $800 per year for hydrants, and the Grand Trunk Ry. $600 for their supply.

Goffstown, N. H.—Surveys have been made for a new water supply. Address Kendrick Kendall.

Portsmouth, N. H.—A resolution has been passed by the City Council authorizing the purchase of the aqueduct company's works at $151,800.

Burlington, Vt.—A large amount of 10, 6 and 4-in. pipe is to be laid this season to replace cement pipe in the lower part of the city.

Winchester, Mass.—Sealed proposals for completing the South reservoir dam will be received by the Board of Water Commissioners until June 25. Plans, specifications and instructions to bidders can be seen at the office of the water board. Percy M. Blake, of Hyde Park, is the engineer.

Springfield, Mass.—A report upon the question of improving the city's supply, submitted by Consulting Engineers Fteley and Herschel, has been adopted by the Water Commissioners, and an engineer is to be appointed at once to make surveys and prepare plans and estimates for carrying out the scheme. They refer to the contamination of the water by algæ, disapprove of the plan to cut up the basin into three sections, and endorse the plans of the commissioners, which is to build a dike across the reservoir near the gates, and bring directly into it the waters of High and Broad Brooks by canals, bringing Ax Factory and Jabish Brook water through the latter canal and cutting off the swampy Belchertown reservoir. The commissioners are opposed to experimenting with the engineers' suggestion that the water be aerated.

Newport, R. I.—The contract of the Newport Water Works Co. for connecting the water pipes at Fort Adams with those of their plant in this city will soon be completed, after which they will no longer rely upon the driven wells on the reservation.

Jamestown, R. I.—The officers of the Jamestown Light and Water Co. are: President, George E. Carr; Treasurer, G. Norman Weaver; Secretary, Arthur Commerford. The pumping station, to be 30 ft. by 40 ft., is now being constructed.

MIDDLE.

Brooklyn, N. Y.—Commissioner Adams has sent a request to the City Council to be permitted to spend $60,000 for a pumping engine at the Prospect Hill reservoir.

Kingston, N. Y.—Preliminary steps have been taken by the city to purchase the company's works.

Gloversville, N. Y.—The Board of Water Commissioners have passed an order authorizing the purchase of 3,200 ft. of 4-in. pipe, with the necessary connections.

Laurens, N. Y.—Works will probably be built this season. Address P. K. Strong or W. L. Hopkins.

Berlin, N. Y.—Articles of incorporation of the Berlin Water Co. have been filed with the Secretary of State. Capital, $5,000. The purpose of the company is to furnish a water supply. The trustees are: William F. Fay, Horace C. Gifford and William F. Rogers.

Freehold, N. J.—James S. Yard, Chief Town Commissioner, has sent us the following information:

On June 9 a majority vote of 281 was cast in favor of constructing works. The Town Commissioners have appointed John Enright, Acton C. Hartshorne and Joseph Brakeley commissioners to construct the works. They will appoint a consulting and supervising engineer, and at once proceed to work. It is expected that the new works will be in operation by Jan. 1, 1891.

Madison, N. J.—A majority vote of 156 has been cast in favor of issuing $75,000 of bonds for establishing a water supply.

Corry, Pa.—The dam near the pumping station gave way on June 13.

Beaver Falls, Pa.—Work on the Valley Water Co.'s new 2,000,000-gall. reservoir will soon be commenced. It will be located near Fetterman.

McKeesport, Pa.—The City Council has authorized the superintendent to purchase from the National Pipe Foundry, of Scottdale, sufficient pipe for extensions to cost about $10,000.

Homestead, Pa.—The construction of new works will be commenced early in 1891. Water will be pumped either from artesian wells or the Monongahela River to a reservoir. Pipe for 6 to 8 miles of mains, together with engine, pumps, hydrants, valves, etc., will be purchased this season. Information can be obtained from M. P. Schooley, Secretary Water-Works Committee.

Allegheny, Pa.—An ordinance has been passed by the City Council authorizing the issue of $100,000 of water bonds.

Washington, D. C.—In answer to a resolution of inquiry adopted by the Senate respecting the Washington aqueduct, Gen. Casey, Chief of Engineers, submitted a report. He states:

It is feasible to complete the tunnel according to the original plan, but I recommend that a test be first made, covering nine months or a year, to determine whether or not the leakage of water into or from the tunnel is sufficient to be a source of impurity or danger great enough to make its successful use questionable. To complete the tunnel would require $500,000; to complete the reservoir, $140,000. Of this amount $302,077 is now available. To put a 3-ft. iron pipe through the tunnel would cost $949,500. Besides the objection of increased cost, there is also that of inexpediency in using pipe at the pressure to which it would be subjected, and the depth at which it must be placed.

SOUTHERN.

Bradford Springs, Va.—J. R. Mabin may be addressed for information.

Goldsboro, N. C.—The city has made a proposition to the water company for the extension of its system to Webbtown and Widow's Hill.

Statesville, N. C.—A citizens' vote will be taken on July 7 to decide the question of granting a franchise for works to be constructed upon the rental plan. If carried the contract would require about 6 miles of mains and 50 hydrants. Address D. A. Miller, Mayor.

Americus, Ga.—A vote will be taken on June 10 to decide the question of issuing $25,000 of water bonds.

Columbus, Ga.—The City Council has passed a resolution appropriating $3,000 for the joint experiment with the water company to sink an artesian well for increasing the water supply.

Griffin, Ga.—A committee has been appointed to confer with different companies and report the cost to the city for establishing a water supply system.

Savannah, Ga.—The City Council has taken action authorizing the construction of an independent system of works at Springfield plantation, costing $250,000, and the sinking of two artesian wells. Bids for sinking the wells will be received at once. The detailed cost of the Springfield plant is as follows:

Driving 6 wells, connecting to cistern plantation	$ 20,000
Constructing cistern	8,000
One 15,000,000-gall. pumping engine	56,200
Buildings	20,000
Eight boilers	22,700
Forcing main	54,000
Stand-pipe	45,000
Contingencies	12,100
Total	$250,000

Yazoo City, Miss.—The City Council has closed a contract with the Thomson-Houston Electric Light Co. for water and electric light works. The water-works are to be in operation in 12 months.

Vicksburg, Miss.—A test well has been sunk by the Cook Well Co., of St. Louis, Mo., from which water is thrown 25 ft. above the surface in a 6-in. pipe. The well is 1,000 ft. deep. The Cook patent strainers are used.

Richmond, Ky.—The capital stock of the Richmond Water and Light Co. is $200,000. A stand-pipe is to be erected. The officers are: President, A. E. Boardman, Macon, Ga.; Treasurer, E. H. Gorke, Portland, Me.; Secretary, Charles S. Powell.

Kimball, Tenn.—Works will probably be erected by the Kimball Iron Co.

NORTH CENTRAL.

Marion, O.—A satisfactory official test of the new works has been made.

Cleveland, O.—In addition to building the new tunnel, about 30 miles of new distribution mains will be laid. Plans for the proposed extension to the tunnel are being prepared by Engineer Whitelaw.

Indianapolis, Ind.—The Indianapolis Water Co. has closed a contract with the Massillon Bridge Co., of Toledo, O., to put an iron aqueduct in the canal over Fall Creek to replace the wooden structure now in use. 39 ft. waterway will be built, and the present water-box will not be removed. The new structure will cost $7,700, exclusive of the tank.

Madison, Ind.—It is reported that the town is threatened with a water famine. The following is taken from the Cincinnati (O.) *Times-Star:*

The chamber valves of the water-works pumps are cut away with constant rushing through of sand and the machinery is next to useless One set of pumps has been bored and rebored owing to the cutting of the sand until they had become a mere shell, and finally gave way, and the pumps now working are but little better.

Jackson, Mich.—A well is being sunk to secure water for domestic use.

Owosso, Mich.—We have received the following information:

The city cast a majority vote of 1,000 on June 10 to issue $20,000 of bonds for improving the water supply. W. R. Coats, of Kalamozoo, Mich., is the Engineer for the city for the new works.

Evanston, Ill.—The Board of Trustees has passed an ordinance providing for the laying of a new 30-in. inlet pipe. The pipe will extend 2,600 ft. into the lake, 1,200 ft. further than the present pipe extends, and will increase the daily capacity of the water supply from 3,000,000 to 10,000,000 galls. The estimated cost of the improvement is $23,000, which will be covered by special assessment The order for the pipe has been given and work will be commenced at once.

La Grange, Ill.—The construction of a 120-ft. stand-pipe will soon be commenced.

Carrollton, Ill.—At a recent special election held to vote on the issuance of, $20,000 of water bonds, a majority vote of about 200 was cast in favor of their issue.

Chicago, Ill.—The Council Finance Committee has decided to begin work at once to increase the water supply for Lake and Hyde Park, and bids for the improvements at the latter place will be advertised for at once. The estimated cost of the necessary 36, 30, 24, 16, 12 and 8-in. pipe, with valves and connections, is $750,000. City Engineer Northway has the matter in charge.

NORTHWESTERN.

Hampton, Ia.—The question of putting in works is being discussed.

Mason City, Ia.—An additional artesian well is to be bored for increasing the city's supply.

Paola, Kan.—A decree has been granted by the U. S. Circuit Court directing a foreclosure of the mortgage on the Paola Water Co. for $95,250, and the sale of the property in this city at some future time. The decree is in favor of the American Loan & Trust Co.

Winside, Neb.—The new works have been satisfactorily tested.

Springfield, So. Dak.—City Clerk, A. T. Bridgeman has sent us the following:

Contracts will probably be let about July 1, and work commenced on July 15. No definite decision has been made. The plan as now proposed is to issue $4,000 of town bonds for sinking a 3 in. artesian well, and putting in mains. J. H. Stephens, E. W. Monfon, J. C. Young and Reuben Groat are interested in the matter. Samuel Henderson is the Engineer.

Sioux Falls, So. Dak.—The water supply system of the Cook Well Co., of St. Louis, Mo., has been adopted by the City Council for their new water supply.

Meade, Dak.—The works are nearly completed.

Laramie, Wyo.—The question of establishing a system of water works is being agitated. The present water supply is claimed to be insufficient for the city's needs.

Cheyenne, Wyo.—A 1,900,000-gall. covered masonry reservoir, 190 ft. by 55 ft., is being constructed. The walls are to be 15 ft. high by 7½ ft. thick at the bottom by 2½ ft. thick on top, and laid on 6 ins. of concrete placed on bed rock. The estimated cost is $13,000.

SOUTHWESTERN.

St Louis, Mo.—John O'Donnell & Bro. have been awarded the contract for constructing section A of the low service conduit, at $108,0 0.

Gatesville, Tex.—A company is being formed to sink a well and put in works.

Dublin, Tex.—Application has been made to the City Council for a franchise to build works.

Dallas, Tex.—It is reported that the Oak Cliff Water Supply Co. is extending its mains, building a new reservoir and increasing the height of the tower at Oak Cliff 70 ft.

Yoakum, Tex.—City Clerk M. G. Rumsey informs us that the City Council has passed a resolution authorizing this statement:

A proposition has been made, but not accepted in its present form, by a syndicate, to put in water-works under a franchise. A 25-years' exclusive franchise will be given to proper parties to complete works in 12 months. The city will take at the start, 20 hydrants at $50 each per year; a suitable rate to be made for private consumers. The proposed plan is to pump water from artesian wells, or a creek one mile distant, to a stand-pipe. The estimated cost is $35,000. Population, 2,500.

Columbus, Tex.—The City Council has decided to have a well put down.

PACIFIC.

Centralia, Wash.—An ordinance has passed the City Council granting a franchise for a system of works.

Tacoma, Wash.—Dissatisfaction has arisen between the city and the water company, and it is now proposed to raise money and purchase the company's plant or erect new works, to be owned and operated by the city.

Baker City, Ore.—Pipe-laying is progressing rapidly.

Livermore, Cal.—A new pumping station is to be erected, and about 2½ miles of 6-in. mains will be laid.

Los Angeles, Cal.—The Los Angeles Consolidated Water Co. has been incorporated at Chicago, to acquire and dispose of water rights and franchises. Capital stock, $5,000,000. The incorporators are: Edward W. Russell, H. Stuart Derby and E. S. Layman.

Santa Cruz, Cal.—About 12 miles of new mains have been laid this seasen.

Provo City, Utah.—It has not been definitely decided whether the city will put in works or grant a franchise to a company. Parties from Salt Lake City have made examinations, and, it is reported, will make a proposition to the city to put in works to cost $250,000, to be completed before Jan. 1, 1891.

A proposition has been made to the town by Witcher Jones and associates, of Salt Lake City, to establish a complete system of works.

Homansville, Utah.—(Probably a new town, near Eureka, Utah.)—The Homansville Water Co. will probably lay a water main in Church St. Work on the supply main will soon be completed. Fire hydrants have been ordered.

Lewiston, Idaho.—The construction of the new works will be superintended by Engineer Bloomfield, of San Francisco, Cal. The plant, when completed, is to be capable of supplying 2,000,000 galls. of water daily.

CANADA.

Shawville, P. Q.—The question of establishing works is being discussed.

Windsor, Ont.—The citizens have voted to expend $40,000 for improvements.

ARTESIAN WELLS.

Orange Park, Fla.—The 8-in. well which is being put down for the American Missionary Association by Mr. Heffright is intended to supply the college and grounds with water and motive power for the industrial shops in connection with the college.

New Orleans, La.—The following bids have been received by the Board of Fire Commissioners for sinking a well in the Sixth District:

Southern Artesian Well Co., $1,199, guaranteeing a natural flow of 50,000 galls. per 24 hrs.; John A. C. Wadsworth, $1,000, with the same condition, and $1,350 with 65,000 galls. per day, and $1,750 for guaranteeing 100,000 galls. per day.

Mitchell, So. Dak.—The City Council has taken steps to sink another well. Address Mayor Bowdle.

Madison, So. Dak.—Karr & Richey have contracted with the city for a 6-in. well, to be sunk a depth of 1,800 ft. if necessary to secure a flow.

Alvarado, Tex.—A well will probably be sunk.

IRRIGATION.

Baker City, Ore.—A company is to make an effort to reclaim 100,000 acres of land in this vicinity.

Tulare, Cal.—The Tulare Irrigation District has voted $500,000 of bonds for building canals and reservoirs.

Marysville, Cal.—Hamilton W. Gray has been awarded a contract to construct 26 miles of irrigating ditch for the Browns Valley Irrigation District. The total cost of the ditch will be $70,000.

Pueblo, Col.—Five new irrigating canals have just been opened for use in the Arkansas Valley, ranging from 19 to 83 miles in length. Two more are in preparation for next year, of which one is the "State ditch," having its source in the Grand Cañon of the Arkansas River. After leaving the river it will pass through a limestone ridge by means of a tunnel, 500 ft. long.

Chicago, Ill.—The Sierra Valley Water Co. has been incorporated at Chicago to distribute water for agricultural and mining purposes. Capital stock, $500,000. The incorporators are F. R. Spear, Charles Jouvenah and J. C. Polley, Jr.

Beckwith, Neb.—An artesian well is being bored. The water is to be raised by pumping, and used for irrigation and fire purposes.

Pueblo, Col.—The statement of the Colorado Land and Water Co.'s ditch has been filed with the County Clerk by T. C. Henry, President. The company is the successor of the Colorado Land and Canal Co. About three-fourths of the company's ditch is already completed. The head gate is located on the north bank of the Arkansas River in the northeast quarter of sections 10, 21, 62.

Australia—J. West, a wealthy land owner of Victoria, Australia, is making investigations in California for his government on the subject of irrigation, and is to make an exhaustive report on the matter. It is intended to introduce the best system in vogue here into the colonies. He will visit every location where irrigation works of any magnitude are found or are in contemplation, and will also meet Maj. Powell and examine his plans in reference to the irrigation of the arid region west of the Rocky Mountains.

SEWERAGE AND MUNICIPAL.

Sewerage.—The City Council of Baltimore, Md., has appropriated $48,000 to construct a sewer on Smallwood, Franklin and Pulaski Sts.

Plans for the sewerage of Ypsilanti, Mich., have been prepared by W. R. Coats, C. E., of Owosso, Mich., and work will be begun during the summer. The same engineer has been engaged to draw up plans for the sewerage of Mobile, Ala.

The surveys for the sewerage system of Knoxville, Tenn., are being made by Messrs. Wright and Wood, of that place. The system will be designed by R. F. Hartford, C. E., of Chattanooga, Tenn

Three new sewers are to be laid in St. Johns, N. B.

Baltimore, Md., has appropriated $38,500 to construct a sewer in Read St.

At Rochester, N. Y., pipe sewers will be laid in North, Clifford, Orange, Walnut, Murray and Emerson Sts., Brayer Place and Loraine Park at an estimated expense of $8,500.

Columbus, O., will construct a main trunk sewer in Third St.

The Elliott St. sewer in Cambridge, Mass., is to be rebuilt.

Work will be begun at once on the sewerage system of Brunswick, Ga.

Sewers have been ordered in the following streets of Gloversville, N. Y.: Fifth, Temple, Prospect and East Pine. They are to be of vitrified pipe, 25% of their cost being born by the town and 75% by the adjoining property holders.

The sewerage plans of Salt Lake City, Utah, have been rapidly carried out and about 10 miles of 24 in. main and 8 to 10-in. lateral lines laid. Much of the pipe passed through quicksand and had to be laid on piles; two piles varying in length from 18 ins. to 7 ft. being required for each length of pipe.

The bids for the Greene Ave. sewer in Brooklyn were opened last week with the following results: The bidding was on two sections, the first from the Gowanus through Butler St. and Fourth Ave. to Dean St., and the second from Dean St. through Fourth Ave. to Hanson Pl., through Hanson Pl. to Greene Ave. and thence to Marcy Ave. The estimated cost of the work, according to the calculations of the Engineers' Bureau, was $1,000,000, and this was the amount which the Legislature authorized to be expended.

Section 1.—Daniel J. Crean, $120,000; John McNamee, $167,000.

Section 2.—Charles Hart, $556,000; John H. O'Rourke, $608,000. Total cost of the sewers, if the lowest bids are accepted, $876,000.

Street Work.—Cottage City, Mass., has voted $500 for concrete.

The Cambridge, Mass., board of aldermen have decided to purchase 600 tons of cobblestone, and a 15-ton steam roller.

Commissioner Adams has sent to the Board of Estimate of Brooklyn, N. Y., his estimate of the amounts required for the use of the Department of City Works during the year 1891. The total is $1,599,937 as against $1,611,119, appropriated for the current year. The estimate of interest in these columns is summarized as follows: Maintenance and construction, $1,443,980; lighting streets, $480,000; lighting new streets, $20,000.

The following streets in Gloversville, N. Y., will be paved during the summer: East Fulton, Main, Church, Bleeker, and West Fulton.

Maria Ave., in St. Paul, Minn., is to be paved with cedar blocks on a plank foundation.

A petition is in circulation in Albany, N. Y., for the passage of a law to pave Green St. with granite blocks.

Gov. Hill has signed a bill amending the charter of College Point, N. Y., by the provisions of which the trustees are empowered to raise by taxation, in addition to the sum formerly authorized to be raised, $5,000 in any one year, and such sum so raised shall be applied each year to the repairing and maintenance of the streets and public places.

At Baltimore, Md., an ordinance has recently been passed to repave Broadway from Canton Ave. to Baltimore St., with asphalt blocks, the city to pay all expenses.

At Philadelphia, Pa., work is progressing rapidly on Great Penn Ave. which will connect Germantown with

Fairmount Park. All the land along the avenue has been purchased by capitalists, who propose to erect thereon a number of handsome suburban houses. The work of grading and filling in has advanced to within a short distance of the Norristown branch of the Philadelphia & Reading R. R. The syndicate has asked the city to construct a bridge for the railroad to pass over in place of the embankment which now reaches across the hollow. It is estimated that the bridge will cost $40,000 to $50,000. The roadway on the avenue will be 80 ft. wide and will be finished after the Telford pattern or paved with brick. Broad footwalks will be laid on each side. It is expected that the work east of the railroad will be completed this season.

At Baltimore, Md., $12,000 has been appropriated by the City Council to pave the streets about Hanover Market with Trinidad asphalt.

The following summary of the work done by the Board of Public Works of St. Paul, Minn., shows that there has been considerable activity in that city during the last fiscal year:

	Miles.	Costing.
Streets opened, widened, etc.	11	$129,751.45
Easements for slopes, etc.	8	2,046.80
Grading streets and alleys	56	461,858.08
Changes of street grades	11	9,737.58
Sewers constructed	16.6	510,129.45
Streets paved	9	333,527.35
Bridges built	....	473,862.17
Miscellaneous structures	...	1,638.00
Street sprinkling	90	54,239.19
Stone and cement walks	2	24,807.31
Wooden sidewalks	65.8	115,980.06
Parks	...	278,756.99
Total	....	$2,395,756.99

The street force employed on all classes of maintenance work has averaged for the year 327 men and 76 teams, and the cost of the same in wages, material used and general wear has been $286,373.89.

Gas Works.—The test recently made at Saratoga, N. Y., of the J. S. Andrews newly-invented process of making illuminating gas out of petroleum, and known as the Acme Gas Fluid, was so satisfactory that the Saratoga Gas Co. will adopt it.

The Edgewood, Pa., council has granted to the Philadelphia Gas Co. the privilege to lay a 10-inch main for a short distance on Swissvale Ave., so as to enable the company to supply their patrons in Edgewood better. Permission has also been granted the Southern Gas Co. to lay a 16-inch high-pressure main through the borough limits, so as to reach the mills at Rankin Station, on the Baltimore & Ohio R. R.

City Bonds.—The town council of Oakland, Md., has decided to issue $10,000 of bonds for street improvements.

The city of Gainesville, Ga., has decided by a popular vote to issue $40,000 of bonds for electric light and water works.

Hastings, Neb., has sold $40,000 of city sewer bonds at par. The bonds run 20 years, with an option to redeem at any time after 5 years.

Buildings.—A six-story hotel costing $250,000 will be built on Santa Fe Ave., Pueblo, Col. A large business block will be started on the same avenue about July 15.

Caldwell, Ky., is to have a new jail.

ELECTRICAL.

Electric Lighting.—The Consumers' Electric Light Co., of Chicago, Ill., will increase its capital stock.

The contract for the electric light plant at Morganton, N. C., has been given to the Westinghouse Electric Light Co.

At Baltimore, Md., the ordinance authorizing the Mayor, Comptroller and General Superintendent of lamps to make a contract for lighting the streets of the city with electric arc lights has been passed. The ordinance provides that proposals shall be advertised for twice a month during June and July. The contract is to begin Aug. 1, and run five years, with the privilege to the Mayor and City Council of terminating it at the end of two years. No bid at a greater rate than 40 cts. per light per night will be accepted.

The Kimball, (Tenn.) Town Co. contemplates erecting an electric-light plant.

An electric-light company has been formed at Kittanning, Pa., and the plant will probably be in operation in a few weeks.

Work has been begun on the new electric-light plant at Medina, N. Y.

At Chicago, Ill., the promoters of the People's Electric Light Co. are demanding that the city carry out the provisions of contract entered into between that company and the old town of Lake for the maintenance of 200 arc lights at $12.50 a lamp per month, and the city will probably refuse to do so on the ground that one corporation cannot bind a succeeding similar corporation to a contract. The contract has been submitted to the city officers. It is dated July 13 of last year, and is specific as to lamps, their location, the rate, and the time of the contract, a period of four years.

Poles are being set for the Provo, Utah, Electric Light Co.

The Troy, (N.Y.) Electric Light Co. will probably be dissolved and the plant bought by the gas company of that city.

The Milledgeville (Ga.) Electric Light Co., will greatly increase its plant.

A large amount of new machinery for their electric railway and light plants has been ordered by the Laredo, Tex., Improvement Co.

The Missouri Electric Light & Power Co., of St. Louis, Mo., has been ordered to erect 68 additional alley lights under its city contract. The extra lights ordered are principally in the Second, Third, Nineteenth, Twentieth, Twenty-first and Twenty-fifth Wards.

A contract was made yesterday with the Laconia Electric Light Co., to light Lake Village, N. H., from the station in Laconia, at $1,200 a year.

The Little Rock (Ark.) Electric Light Co. has been bought by G. H. Van Etten.

L. M. Fishback, representing the Thomson-Houston Electric Co., has submitted a proposition to the town council of Yazoo City, Miss., for the erection of an electric light plant and the construction of water-works at an estimated total cost of $40,000 to $50,000.

The Streator Gas & Light Co. has been incorporated to furnish electric light to the city of Streator, Ill. Capital stock, $100,000. The incorporators are: W. H. Gillette, E. H. Hughes and S. T. French.

A $7,000 incandescent electric light plant will be erected at Falls City, Neb.

The Calkin Electric Lighting Co., of St. John, N. B., has ordered a plant to supply 350 arc and 4000 incandescent lamps. It is under contract to supply the city with arc lights for the streets of the east side of the city.

The National Electric Development Co. has been chartered in San Francisco. Directors: George A. Davis, John C. Turner, Henry C. Miller, Charles D. Cushing and C. J. Tallon, of San Francisco. Capital stock, $500,000. The company will engage in a general electric, engineering and contracting business.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Shelburne Falls, Mass.*—The following bids were received for the construction of the bridge across the Deerfield River at this place:

Vermont Construction Co.	$14,999
Pennsylvania Bridge Co.	16,200
King " "	16,610
Berlin " "	17,290
Groton " "	16,750
Hilton " "	17,500
Canton " "	18,000
Pittsburgh " "	18,326
Boston Bridge Works	16,202
Rochester " "	16,369
Wallace Iron " "	20,800
New Jersey Steel and Iron Co.	22,067

The contract was awarded to the Vermont Construction Co., of St. Albans, Vt.

Brooklyn, N. Y.—The following bids have been received for the bridge to be built across the arm of the lake in Prospect Park:

King Bridge Co.	$53,758
Harris & McGuire	54,797
L. E. Brown	55,700
Poulson & Eger	60,693
John J. Hopper	52,925

The following bids were received for the iron work separately:

Wallis Iron Works	$15,542
Poulson & Eger	18,000
Post & McCord	18,520

Those for stone work separately:

King Bridge Co.	$36,758
L. E. Brown	37,000

The contract for the iron work was awarded to the Wallis Iron Works, and for the stone work to L. E. Brown. The structure is to be of iron and granite, with a total length of 128 ft. The water span is 68 ft.; height to top of arch 22 ft., height to roadbed, 28 ft. and height to top of parapet, 31 ft.

Rochester, N. Y.—The plans and specifications for the bridge across the Erie Canal are completed, and bids will soon be asked for.

Front Royal, Va.—The Front Royal Improvement Co. will build iron bridges. Address, G. W. Cone, Vice-President.

Wheeling, W. Va.—The Wheeling Bridge & Terminal R. R. Co., which is building the Belt Line and Union railroad bridge, announces the perfection of its plan for the completion of its lines on the Ohio side of the river, including a steel double-tracked viaduct 400 ft. high by 1,500 ft. long, and also announces additional facilities in Wheeling, including the definite location of its freight and passenger union stations, the building of a new bridge and branch lines in East Wheeling, and also the erection of massive retaining walls along Wheeling Creek. The new work is to cost $500,000 or more.

Minneapolis, Minn.—The following bids were received for the Second Avenue bridge. The bridge will be of iron, and will have four spans of 506 ft. in length, with a roadway of 18 ft., and walks 6 ft. wide on either side.

Milwaukee Bridge Co.	$35,370
Canton Wrought Iron Bridge Co.	38,900
Shiffler Bridge Co.	40,600
Chicago Bridge & Iron Co.	35,518
Keystone Bridge Co.	43,600
King Bridge Co.	43,000
Wisconsin Bridge Co.	39,257
South Bridge Co.	42,498

There were four bidders on the substructure, but the bid of E. F. Comstock & Co., of Minneapolis, was found to be the lowest, being as follows:

Granite, per cubic yard	$35 00
Mankato stone, per cubic yard	11 00
Piling, per lineal foot	26
Lumber, per thousand	20 00
Excavation, per yard	1 00

Leavenworth, Kan.—The Senate has passed the bill authorizing the construction of a drawbridge across Missouri River at this place.

Monterey Co., Cal.—Bids will be received until July 1 for the construction of a bridge over Carmelo River. H. Samuels, Board of Supervisors, Monterey Co., Cal.

Humbolt Co., Cal.—Bids will be received until July 15 for the construction of a bridge across Eel River at Alder Point. A. D. Stern, Clerk, Eureka, Cal.

Canals.—About $500,000 will be expended on New York State canals this season. Advertisements for the work on lengthening the locks, building the new canal bridge at Rochester and for dredging the Hudson River between Troy and Coxsackie, will be out soon. A considerable amount of work will also be done in repairing the towpaths of the Champlain Canal.

The preliminary survey for the canal from the lake at the mouth of Blue Cañon to the mouth of Powder river cañon, south of Baker City, Ore., has been completed and the route found to be feasible. The project involves the division of the canal at a point near the mouth of Powder river cañon into two branches, the one for the east side of the valley to be carried across the cañon in a big flume, and taken thence around the bluffs and below the city reservoir, finally covering the sage brush lands out below the Gordon mine

CONTRACTING.

Streets.—The Board of Public Works of St. Paul, Minn., has awarded the contract for grading Case St. to Thomas Linnan, at $1,200.

The following bids for bridges were received at Portland, Ore., June 8:

The Gordon Creek bridge, George F. Rich & Co., $425; E. A. Webster, $770; C. F. Rayer, $850; E. S. Bramhall, $395; C. C. Redman, $490. Bridge on the White House road, George F. Rich & Co., $460; E. A. Webster, $425; C. F. Rayer, $375; C. C. Redman, $475. For the two bridges on section line 303, one 110 ft. and one 88 ft., George F. Rich & Co., $720; E. A. Webster, $770; C. F. Rayer, $761; C. C. Redman, $680. The White House road bridge contract was taken under advisement. The others were in each case let to the lowest bidder.

Swigart & Shepherd, of Beatrice, Neb., have been awarded the contract for curbing districts 4 and 5 at 66.7 cts. per lin. ft. The curbing is to be of Colorado sand stone.

At a meeting of the Common Council of Amsterdam, N. Y., the following bids for paving Market St. with fire brick were opened: Hotaling & Brate, $2.66 per sq. yd.; William H. Stager, $2.57; Bernard Machold, $1.48. As the property holders on Market St. stipulated in their petition that the paving should not cost over $2.50 per sq. yd., all the bids were rejected. Mr. Machold's bid of $1.48 did not include the furnishing of brick.

The following bids were received for paving Abbott Road, Buffalo, N. Y.: Barber Asphalt Paving Co., $145,485; Vulcanite Co., $141,516. The Barber Co. was the lowest bidder for paving William St., at $34,190. The lowest bid for relaying Canal St. was $5,641, from L. McGregor.

Bids for grading Ottawa Ave., St. Paul, Minn., have been received as follows: Thornton & Shaw, $4,685; Thos. Linnan, $5,161; Jerome A. Chute, $6,232; William H. O'Brien, $4,900; Charles E. Sandeen, $5,300; J. T. Million, $5,344; Thomas McDermott, $6,981; John W. Maloney, $4,600. The contract was given to John W. Maloney. Thornton & Shaw received a $31,900 contract for grading the so-called levee. The following table gives a summary of the bids for construction, relaying and opening of such stone sidewalks as may be ordered by the common council from April 1, 1890, to Nov. 1, 1890.

	Lauer Bros.	W. H. Ulmer.	T. M. Breen.	Chas. Stone.
Bedford stone, 10,000 sq. ft.	av. 52.8c.	av. 53.1c.	av. 46.6	av. 48c.
Berea stone, 10,000 sq. f.	av. 46c.	av. 47c.	av. 52.4	av. 48c.
Curbstone, 1,000 lin. ft	$1.00	$1.02	$.90	$.88
Corners, curbstone, 200 lin. ft.	2.00	1.95	1.80	1.10
Resetting curb, 500 lin. ft.	.15	.16	.10	.12
Relaying stone walk, 1,000 sq. ft.	.08	.10	.07	.10
Rubble masonry, 300 cu. yds.	3.75	3.50	3.50	3.00
Dry rubble masonry, 100 cu. yds.	3.50	3.75	3.00	2.00
Brickwork, 16,000	14.00	14.50	13.00	15.00
Pine-block paving, 300 sq. yds.	1.80	1.70	1.60	1.10
Earthwork, 500 cu. yds	.48	.50	.40	.60
Railroad rails, 60,000 lbs	.02	.01⅞	.02⅛	.01⅞
Wrought iron, 1,000 lbs.	.04¼	.04½	.04	.02¾
Lumber, 2,000 ft., B. M.	.02¾	.02¾	.02	.02
Total amount	$15,206.50	$15,152.20	$14,873	$13,945

One bid on Kettle River sandstone by Charles Stone and one bid on white Kasota stone by Thomas M. Breen not considered in above tabulation. Whole bid of Chas. Stone rejected as informal.

Bids were recently opened for the curbing of Minnesota Ave., Kansas City, Kan., and the contract awarded to J. E. Riley at 42 cts. The contract for paving the avenue was awarded to the Kansas Paving & Construction Co., at $1.29.

At Nashville, Tenn., the Board of Public Works has awarded the contract for constructing sidewalks and gutters on Bell St. to Burt McGhee.

Buildings.—The contract for the new power house of the Citizen's Electric Light Co. of Braddock, Pa., has been awarded to Packet & House.

The following bids for putting in the foundations of the new public buildings at Detroit, Mich., were opened June 14. Joseph L. Gearing Detroit, submitted 17 different propositions. He agrees to complete the work by August 1, 1892 and will do it according to the materials decided for sums ranging from $120,528 for Berea sandstone throughout to $203,436 for granite throughout. Among his other bids were $124,183 for blue Amherst throughout, $130,667 for buff Bedford throughout, $141,461 for blue Bedford throughout and 180,565 for Medina throughout. His other bids ranged from $123,851 to $182,560, and contemplated the use of several kinds of stone in the walls. E. F. Goebel, of Chicago, made his main bid, $163,500; material, Ohio blue sandstone; time of completion, 12 months. His other bids for different materials ranged from $10,000 below that figure to $20,000 above. Patrick Dee's bid was $116,564 Material, Bedford limestone; time of completion, two years. David Knapp, of Detroit, for limestone and Maine granite in ten months, $182,225. Alex. Chapoton, Jr., to complete the work in one year, $188,445, using Portage red, $178,495, Bedford, $215,642 Sioux Falls anite, $178,495, Berlin Heights buff or blue, $213,495 Concord, and $178,495 Amherst. McCarthy & Baldwin, of Washington, $149,431 for all the granite, to be finished in 15 months. For granite and limestone, $132,600, to be finished in one year. John Moore, of Syracuse, $149,000 for Maine granite and Bedford limestone, $209,000 for all granite. He agrees to complete the work in 300 days.

Buoy Chains.—The Lebanon Iron Works is to supply the buoy chains to the United States during the year. It is said to be the largest contract of the kind ever given by the government, and will keep the works running to their full capacity the entire year.

Bridge.—The Wallace Iron Works, of New York, has received the contract for erecting a bridge in Prospect Park. The price is $15,542.

PROPOSALS OPEN.

Flagging, Grading and Curbing.—Thomas F. Gilroy, Commissioner of Public Works, New York. June 24

Improvement of 155th St.—Thomas F. Gilroy, Commissioner of Public Works, New York. July 1.

Brick Pavement.—R. F. Allender, Martin's Ferry, O. Furnishing and laying about 12,500 sq. yds. July 3.

Water Works.—Sealed proposals will be received until July 7, by A. O. Rupert, Auditor, Fargo, No. Dak., as follows:

1. For constructing a pumping station, and putting in a complete new water system, including power, mains, hydrants, and settling basin and all things necessary to supply the city with water and fire protection, in accordance with the plans and specifications now on file, requiring about 1,270 ft. of 12-in. pipe, 1,125 ft. of 10-in.pipe, 8,825 ft. of 8-in. pipe, 33,770 ft. of 6-in. pipe, 5,894 ft. of 4-in. pipe, 71 hydrants, and 41 service and valve boxes. Proposals also to state the additional cost in case the city shall decide to take its water supply from a point about 1½ miles outside of the city limits.

2. For extending the water system now in operation so as to cover the circuit indicated in said plans and specifications, requiring about 1,625 ft. of 8-in. pipe, 15,400 ft. of 6-in. pipe, 2,362 ft. of 4-in. pipe, together with hydrants and service and valve boxes, in accordance with plans and specifications.

Dredging.—Dredging and otherwise improving Muddy River. Board of Park Commissioners, Brookline, Mass. June 24.

Paving.—Cleveland, O.—Grading, draining, curbing, paving with common Medina stone, joints to be filled with concrete, and improving Clark Av., between Pearl St. and the C. C. C. & St. L. Ry. tracks. Board of Improvements, City Hall. July 10.

Jail.—In Monroe Co. H. C. Kock & Co., Milwaukee, Wis.

Orphans' Home.—Brick building, 90 × 142 ft. A. P. Doe, Davenport, Ia.

Bridge.—For constructing an iron bridge on Grant St., over Scajaquada Creek. Geo. C. Mann, City Engineer, Buffalo, N. Y.

Cedar Pavement.—Laying about 9,680 sq. yds. of cedar block pavement and 3,500 lin. ft. of wood curb. J. K. Setright, of Marinette, Wis., July 1.

School House.—J. T. Wells, Plain City, O. July 3.

Water-Works.—Nelson Tift, Albany, Ga., will receive bids for sinking an artesian well 750 ft. deep, erecting a brick tower 100 ft. high with tank on top, 20 × 35 ft., and boiler, engine, pump and pipes with capacity to elevate 50 to 100 galls. per minute to the tank.

Sewer.—The Board of Public Works, Duluth, Minn. for constructing a storm sewer. Also a sanitary sewer. June 26.

Excavating.—Proposals will be received by the Board of Public Improvement, of St. Louis, Mo., for furnishing all materials, tools and labor required for excavating, piling and concrete footings required for the new City Hall. There will be about 18,400 cu. yds. of excavation, 18,000 lineal ft. of oak piling and 5,200 cu. yds. of concrete footings.

Filling.—Quantity, 200,000 to 400,000 cu. yds., at Marine Park, South Boston. Department of Parks, 37 Milk St., Boston, Mass. June 30.

Granite.—About 21,240 cu. ft. of headers and stretchers. Dock Commission of New York. July 3.

Granite Pavement.—Thos. Gilroy, New York. June 30.

Sewers.—Board of Public Works, St. Paul. July 3.

Electric Light.—Arc or incandescent plant. Mayor, Monroe, Mich. June 30.

Gravel Road.—Maj. J. W. Scully, Corinth, Miss. July 14.

Railroads.—About 200 miles of grading and tracklaying. J. S. McTigh & Co., Macon, Ga.

Sewers.—Board of Public Works, Duluth, Minn. June 26.

Cedar Pavement.—About 16,000 sq. yds. C. Honkomp, Sedalia, Mo. June 24.

Sewer.—E. O. Ross, Troy, N. Y. June 24.

MANUFACTURING AND TECHNICAL.

Filter.—The Oliphant filter, manufactured by the Hegeman & Oliphant Filter Co., of 112 Liberty St., New York, has been adopted by the Spreckels sugar refinery at Philadelphia, and a 5,000,000 gall. plant erected. The working of the plant, which works by upward filtration, is said to have been highly satisfactory in all respects.

Steam Road Roller.—The Harrisburg (Pa.) Machine Co. will furnish a 10-ton double engine Harrisburg steam road roller to the City of Troy, N. Y. It is guaranteed to ascend a grade of 14 ft. to the 100 ft. on soft ground, and a grade of 18 ft. to the 100 ft. on hard ground.

Armored Cruiser No. 2 will be built in the Cramps' yards, giving employment to several hundred men for about 3 years. The new vessel will cost $2,985,000, and will be constructed according to the government plans as modified by the Cramps in their bids.

The new vessel will be 350 ft. long, 64 ft. 2½ ins. wide in the extreme, and 41 ft. 3 ins. deep. She will have engines of 16,000 H. P., and must go at the rate of 20 knots an hour For every quarter knot above that speed the contractors will receive a premium of $50,000; for every quarter knot deficiency they must pay a penalty of $50,000, as they will in the case of the *Philadelphia* within the next 10 days. It is thought, however, that she will go 22 knots an hour, which if true, will mean a premium of $400,000 for builders.

The contract for the 5,500-ton cruiser, for which the Cramps did not bid, was awarded to the Union Iron Works, of San Francisco.

Water Pipes.—The St. Thomas, Ont., Pipe & Foundry Co., has been formed for the manufacture of water pipe. The capital stock is $50,000.

Road Rollers.—Aveling & Porter steam road rollers, have been purchased by Evanston, Ill., Dolesi & Shepherd, of Chicago, and the Hoboken Land and Improvement Co., Hoboken.

Snowsheds.—About 40 miles of snowsheds will be built on the Central Pacific Ry. this summer at an estimated cost of $250,000.

Locomotives.—The Schenectady (N. Y.) Locomotive Works, has built and delivered two consolidation engines to the East Tennessee & Georgia R. R., at Knoxville.

The Portland Co. will soon deliver to the Maine Central R. R. a heavy mogul locomotive. The engine is one of the heaviest ever built by the Portland Co., and heavier than any on the Maine Central. It is intended for passenger service on the mountain division. The cylinders are 19 × 26 ins., and the driving wheels, 5 ft. 5 in. in diameter.

Five new locomotives have been sent to the Ogdensburgh & Lake Champlain division of the Central Vermont, by the Baldwin Locomotive Works.

Cars.—The Broadwater, the first of the ten new dining cars of the Northern Pacific line, has been put in commission.

The Arnold Refrigerator Car Co. has been incorporated to manufacture refrigerator cars at Chicago, Ill. Capital stock $10,000,000. The incorporators are A. Bierbower, J. W. Merriam and Robert Van Sands.

A Good Dredging Record.—The following notes are furnished by the engineer in charge of the Calhoun Co. Iowa, dredging work, Mr. John G. Spielman: Dredge No. 4, Bucyrus Dredge & Steam Shovel Co., maker: dipper 1½ cu. yds., engines 8 × 12 ins., depth of cutting 5 ft., base 6 to 10 ft. Work done in 27 working days of 10 hours each, 12,672 lin. ft. After deducting 3 days for repairs and changes this makes a daily average excavation of 1,574 cu yds. The material was a soft, sandy soil with occasional pockets of very hard clay and gravel. Mr. Spielman asks whether this record has ever been surpassed. At the same place Dredge No. 2, Marion Steam Shovel Co. maker, did in the same time as above 6,204 lin. ft., or 30,720 cu. yds., or an average daily excavation of a 1,280 cu. yds. In this case the dipper capacity was 1¼ cu. yds., engine 9 × 12 ins., cutting 8¼ ft. deep, base 6 to 10 ft., and the material was a hard, sticky clay. This is also an excellent record.

Freight Car Brakes.—The Westinghouse Air Brake Co. is now turning out work as fast as possible, both at Wilmerding and at the Allegheny Works. The process of moving the works to the new shops at Wilmerding is owing to the great demand for air brakes, making very slow progress. A large number of orders for brakes have recently been received, among them contracts for 1,000 sets of freight brakes for the Atchison, Topeka & Kansas R. R.; 2,000 for the Hicks Stock Car Co., of Chicago, 500 for Chicago, Milwaukee & St. Paul R. R.; 4,000 for the Union Pacific, and 300 for the Street's Western stable car line, of Chicago.

The Cowles Aluminum Co. are talking of establishing another plant, on a much more extensive scale than their somewhat experimental one in Lockport. It will cost about $2,000,000. Several members of the company are in favor of putting it in as an addition to the present Lockport plant.

Steel and Iron Works.—The first iron and steel bridge works in West Virginia are now in running order, and have turned out several small structures. The plant is located at Huntington, and owned by Ingram & O'Neil.

The Milwaukee Bridge & Iron Co. contemplates the erection of a new plant at Milwaukee. The main building will be 600 × 100 ft., and the works, exclusive of machinery, will cost $175,000. The working force will be doubled.

The foundations for the addition to the structural iron works on Seventh street, New Albany, Ind., have been completed and work will be at once commenced on the iron building. The machinery for the enterprise, is in course of construction, and will be ready to be placed in position as soon as the building is completed. The works now cover about 8 acres of ground, and when the additions are completed, this will be one of the most extensive establishments of its kind in the U. S. The same company owns and operates the Premier steel works at Indianapolis. It is the intention of the company to manufacture the steel ingots at the Indianapolis establishment by a new process, and ship them to this city to be manufactured into such shape as the market may require. The works have been for several years engaged in the manufacture of cable street railway material, and have now on hand contracts that will occupy some months to fill.

W. F. Mattes, Superintendent of the West Superior (Wis.) Iron and Steel Co., has let the contract for the construction of the iron building for the bessemer department of the plant, together with all the machinery that the company cannot conveniently manufacture at the present time, to the Pittsburgh Iron & Steel Engineering Co. Work will be commenced as soon as the foundation is in readiness to receive the walls. The bessemer building will be 120 × 120 ft. on the ground, and the roof and sides will be of iron. The drawings and specifications for the rolling mill and for its machinery are rapidly nearing completion, and contracts will soon be let. The steel company will manufacture steel rails, shipplates, angles, etc. Within 12 months over $500,000 will be expended on the Bessemer plant, machine shop and rolling mill. About 250 men are now at work, and 1,200 will be employed within one year. James Roosevelt, President, announces that he has decided to erect a row of brick tenements to cost $75,000.

Gas Pipe Tapping Machines.—Walter S. Payne & Co.; of Fostoria, O., manufacturers of water-works supplies and tapping machines have recently sold 12 of their new style patent gas pipe tapping machines.

Metal Market Prices.—*Rails*—New York: $31 to $31.50; for old iron rails, $24.50 to $25.75. Chicago: $35; old rails, $25 for iron, $18 to $21.50 for steel. Pittsburg: $31.50 to $32.50; old rails, $26.50 to $27 for iron, $21 to $22.50 for steel

Foundry Pig-iron.—Chicago: $15 to $17. Pittsburg, $15.25 to $18 New York: $17 to $18.50.

Track Materials.—New York: steel angle bars, 1.90 to 1.95 cts.; spikes, $2 to $2.10; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.85 to 2 cts. for iron; spikes, 2.05; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.10 to 2.15 cts. for steel, and 1.95 to 2 cts. for iron; spikes, $2.00; track bolts, 2.95 to 3.05 cts., with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.35 cts.; Chicago, 4.25 to 4.30 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared steel bridge plates, 2.75 cts.; universal mill plates, 2.40 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.25 to 4.75 cts. for firebox; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.75 cts. for tank. Chicago: angles, 2.25 cts; tees, 2.65 cts.; beams: 3.20 cts.; universal plates, 2.45 cts; car truck channels, 2.40 to 2.50 cts. New York: beams, 3.10 cts., plates, 2.15 to 2.20 cts.; angles, 2.15 to 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts.